Policy Monitor

How US Government Agencies Value Mortality Risk Reductions

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Introduction

Each year, US government agencies promulgate health and safety regulations that impose hundreds of millions of dollars of costs on the national economy. A key issue in developing these regulations is determining whether the value of the associated risk reductions and other benefits exceeds the value of the resources diverted from other purposes. This article explores one component of this benefit-cost comparison: the approaches used by federal agencies to estimate the value of changes in the risk of premature mortality.

After introducing key concepts, the article describes current federal agency practices. It first summarizes US government-wide guidelines for valuing mortality risk reductions and then discusses the practices of individual agencies in more detail. It focuses largely on the approaches used by the US Environmental Protection Agency (EPA). The EPA is responsible for a substantial proportion of all federal life-saving regulations, and mortality risk reductions account for the majority of the monetized benefits for most of its economically significant rules.

Key Concepts

Most major life-saving regulations reduce mortality risks across a wide population and result in a small change in risk for many affected individuals. Economists have developed the concept of a "statistical life" as a method for aggregating these small changes. For example, a regulation that reduces risks by one in one hundred thousand on average throughout a population of a hundred thousand individuals can be described as saving one statistical

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life—as can an effort that achieves an average risk reduction of one in ten thousand throughout a population of ten thousand. Thus a statistical life is an analytic construct; its value is not equivalent to the value of saving the life of a particular individual.

The Value of Statistical Life

In regulatory analysis, the value of reduced mortality risks usually takes the form of a "value per statistical life" (VSL). If, for instance, each member of a population of a hundred thousand was willing to pay $50 on average for a one in one hundred thousand decrease in his risk of dying during the next year, the corresponding VSL would be $50 × 100,000 or $5 million. Generally, economists estimate these values using either revealed or stated preference studies. Revealed preference methods use data from market transactions or observed behavior to estimate the value of nonmarketed goods. For example, in compensating wage differential (or wage-risk) studies, researchers compare earnings across different industries to estimate the additional wages paid to workers in riskier jobs, using statistical methods to control for the effects of other factors (such as education) on earnings. Stated preference methods use contingent valuation surveys or similar approaches that ask respondents to report their willingness to pay (WTP) for reduced risks under hypothetical scenarios. The VSL is most often estimated from studies of compensating wage differentials; however, a smaller number of studies estimate the VSL using contingent valuation surveys.

Agencies face three challenges in valuing mortality risks: they must select appropriate studies from the available literature, they must adapt the study estimates to the regulatory context, and they must combine the results into a point estimate, a range of values, or a probability distribution for use in their analyses. As discussed later in this article, these decisions are influenced by current government-wide guidance and constrained by the available empirical research.

Perhaps the most important and controversial challenge is determining how to address differences between the types of risks studied and the types of risks addressed by federal regulations. For example, compensating wage studies address the risk of accidental deaths among workers who are, on average, in their mid- to late thirties. However, the individuals affected by air pollution regulations are likely to be much older, may face higher baseline risks from conditions unrelated to pollution, and may experience several years of morbidity (e.g., from heart disease or cancer) prior to death. In addition, exposure to pollution may be less voluntary and controllable than the choice of a job.

The Value of a Statistical Life Year

The value per statistical life year (VSLY) is an approach for adjusting VSL estimates to reflect differences in remaining life expectancy and involves calculating the value of each year of life extension. Because the degree of life extension is usually closely related to the age of the affected individuals, VSLY is often interpreted as an approach for adjusting VSL to reflect age differences. It is generally derived by applying simple assumptions to VSL estimates based on Moore and Viscusi (1988).

More specifically, the VSLY is derived by dividing the VSL by the discounted expected number of life-years remaining for the average individual studied. This approach assumes

that the VSL is the sum of the present value of each life-year (the VSLY) weighted by the probability that an individual survives to that year, which is equivalent to assuming that the value of each remaining life-year is constant.[1] The resulting VSLY is then applied to the expected number of discounted life years saved by the regulation (i.e., to the predicted increase in discounted life expectancy).

An example of this approach appears as a sensitivity analysis in the EPA's retrospective assessment of the Clean Air Act (EPA 1997). Assuming that the VSL is $4.8 million (in 1990 dollars), the remaining life expectancy averages thirty-five years for the population studied, and the VSL estimate reflects a 5-percent discount rate, the EPA obtained a VSLY of $293,000. If the average individual whose life is extended by the program would survive for an additional fourteen years (as a result of reduced exposure to pollutants), the present value of the risk reductions would be $2.9 million (i.e., the discounted value of fourteen years × $293,000 per year). In other words, under this approach, the total value of the mortality risk reduction would be $4.8 million for a younger individual who would survive for thirty-five additional years, and $2.9 million for an older individual who would survive for only fourteen more years.

These VSLY calculations, although easy to implement, assume that the VSL is proportional to the discounted remaining life expectancy. As discussed elsewhere in this volume, economic theory places no such restrictions on the VSL, and the available empirical evidence indicates that the relationship between VSL and life expectancy, or age, is more complex. In addition, because it suggests that saving the life of an elderly individual is worth less than saving the life of a younger individual (who has more remaining life years), such adjustments have been contentious when applied in a public policy setting.

Government-wide Guidance

The US Office of Management and Budget (OMB) has primary responsibility for coordinating and reviewing regulatory analyses across federal agencies. The OMB's role is framed by *Executive Order 12866, Regulatory Planning and Review* (1993). This executive order directs agencies to evaluate alternative strategies for all economically significant regulations, which include those with a predicted annual impact on the economy of $100 million or more or with other types of significant effects. The executive order requires the analysis of benefits and costs but its concerns go beyond economic efficiency. It requires agencies to consider distributive impacts and equity as well as nonquantifiable effects.

Current OMB Guidance

Guidance on implementing *Executive Order 12866* is provided in the OMB's *Circular A-4, Regulatory Analysis* (2003). The *Circular* is intended to assist analysts in conducting good

[1] Formally, the approach assumes that the VSL at age j is, $\text{VSL}_j = \sum_{t=j}^{T} q_{j,t}(1+\delta)^{j-t}\text{VSLY}$, where $q_{j,t}$ is the probability that an individual at age j survives to age t and δ is the discount rate. VSLY can be factored out of this expression, and $\sum_{t=j}^{T} q_{j,t}(1+\delta)^{j-t}$ is the discounted remaining life expectancy.

regulatory assessments and to promote consistency across agencies. While the OMB treats some of the guidance as mandatory, it also recognizes that agencies may lack the data and resources necessary to fully comply with many of the recommendations. Thus the OMB suggests preferred practices, yet allows agencies to exercise some discretion in determining how to conduct their analyses as long as sufficient justification is provided for the approach. Ultimately, each individual regulatory analysis is the result of negotiations between the OMB and the agency during the OMB review process.

Circular A-4 discusses a wide range of issues, such as identifying alternative policy strategies, assessing various types of costs and benefits, and analyzing distributional impacts. It includes sections that directly address benefits valuation (briefly summarized below), as well as related topics such as selecting a discount rate and assessing uncertainty.

The *Circular* describes principles that agencies should consider in reviewing the research used to support benefit valuation. For example, it provides lists of criteria for evaluating revealed and stated preference studies as well as for transferring benefit estimates from the studies to different policy contexts. These criteria address whether the study is consistent with economic theory, uses appropriate methods for data collection and analysis, and considers outcomes similar to those anticipated from the proposed rulemaking. Separately, the OMB has issued guidance on quality control and peer review (OMB 2002, 2004), which (in combination with *Circular A-4*) increases the emphasis on assessing the quality and suitability of studies used for valuation. The OMB notes, however, that ultimately the selection of appropriate values will depend on the professional judgment of the analyst because each study is likely to have both strengths and weaknesses. *Circular A-4* repeatedly emphasizes the need to discuss the rationale for selecting a particular approach and to assess associated biases or uncertainties.

In the *Circular*, the OMB also discusses the valuation of mortality risk reductions and suggests that agencies present both VSL and VSLY estimates. The OMB notes that these values are subject to continued research and debate and indicates that agencies should describe the limitations of their chosen approach. The *Circular* reports that the range of VSL estimates found in the literature is generally between $1 million and $10 million; as a result, regulatory agencies generally use values from within this range.

In addition, *Circular A-4* discusses options for adjusting VSL estimates to reflect differences between the scenarios addressed in the research literature and the specific regulatory scenarios being assessed. The *Circular* notes that the available empirical research supports quantitative adjustments to VSL estimates only for changes in income over time and for time lags in the incidence of health impacts. It includes cautions on the application of age adjustments and suggests the use of larger VSLY estimates for older individuals. It also requires that agencies complete a cost-effectiveness analysis as well as a benefit-cost analysis. In cost-effectiveness analysis, regulatory costs are divided by a nonmonetary benefit measure (such as lives or life-years saved) to compute the cost per unit of effect (e.g., the cost per life-year saved), whereas benefit-cost analysis assigns a monetary value to each type of benefit.

The "Senior Discount" Debate

While the OMB was developing *Circular A-4*, a controversy erupted over the "senior discount" implicit in age-adjusted VSL estimates used by the EPA. The EPA's preferred VSL estimates do not vary by age. However, for many air pollution rules, most of the reduction in premature mortality is likely to accrue to individuals aged sixty-five and over rather than to the younger working-age individuals included in most VSL studies. In some of its regulatory assessments, the EPA presented sensitivity analyses based on research suggesting that older individuals are willing to pay less for life-saving interventions than younger adults (e.g., Jones-Lee 1989; Jones-Lee et al. 1993). Many observers objected to this use of lower VSL estimates for older persons in policy analysis. The controversy garnered attention from the media and Congress; advocacy groups ran ads showing "seniors on sale" and, in the fiscal year 2004 Appropriations Bill (H.R. 2673), Congress prohibited the EPA from funding analyses that made these adjustments.

In response, the OMB issued a memorandum advising agencies against adjusting the VSL for age (Graham 2003). This memorandum suggested that more recent research (ultimately published in Alberini et al. 2004a) did not fully support the VSL age adjustment found in earlier studies. It indicated that, when VSLY estimates are used instead of VSL, the yearly values are likely to be higher for senior citizens because "seniors face larger overall health risks from all causes and because they have accumulated savings and liquid assets to expend on protection of their health and safety" (Graham 2003, p. 2). The memorandum also noted that the OMB was developing requirements for cost-effectiveness analysis, which has the advantage of not requiring that a monetary value be placed on risk reductions (although such values are implicit in the ultimate regulatory decision).

However, the guidance in this OMB memorandum, which was eventually incorporated into *Circular A-4*, does not necessarily eliminate the use of different values for younger versus older individuals. When VSLY estimates are applied, the total value of a risk reduction is equal to the product of the VSLY estimate and the discounted number of life-years saved. Unless the VSLY estimates for older individuals are large enough to compensate for the smaller number of life-years remaining, the use of VSLY estimates will result in lower values for older individuals. In addition, the measures most commonly used to value premature mortality in cost-effectiveness analyses are based on life-years lost (see Institute of Medicine 2006) and thus also result in smaller values for older persons.

The number of rules subject to these OMB requirements is small but their economic impact is substantial. For example, in fiscal year 2004, the OMB reviewed only six final rules that were economically significant, included monetized estimates of health or safety benefits, and were subject to *Executive Order 12866* (OMB 2005). However, the OMB calculated that the annual costs of these rules totaled approximately $3.5 billion and their monetized benefits totaled between $12 billion and $107 billion (2001 dollars). Of these six rules, three were the EPA air pollution rules for which reduced mortality risks accounted for a significant fraction (roughly 90 percent) of total monetized benefits. Data for other years show a similar pattern; the EPA air pollution rules account for a significant proportion of all economically significant health and safety regulations and their monetized benefits are attributable primarily to reductions in premature mortality.

The EPA's Approach

The EPA has devoted considerable attention to developing methods for estimating the value of reductions in the risks of premature mortality. While the studies that are used as the basis for these estimates have remained relatively constant over time, the EPA's approach to adjusting the estimates has evolved as the result of continuing research and expert review.

The EPA's Base Estimates

The EPA's VSL estimates are based largely on work completed in the early 1990s to support its retrospective and prospective analyses of the impacts of the Clean Air Act (EPA 1997, 1999a; summarized in more detail in Industrial Economics, Incorporated [IEc] 2001). Reflecting research conducted by Viscusi (1992, 1993), the EPA identified twenty-six VSL estimates suitable for use in its analyses, of which twenty-one were from wage-risk studies and five were from contingent valuation studies.

The mean VSL estimates from these studies ranged from $0.6 million to $13.5 million with an overall mean of $4.8 million (1990 dollars). When updated to 2005 dollars using the Consumer Price Index, the mean of this range is $7.2 million, with a minimum of $0.9 million and a maximum of $20.2 million. The wage-risk studies provide values scattered throughout this range, but the estimates from the contingent valuation studies tend to cluster towards the lower end (see Appendix Table A1).

These estimates rely primarily, but not entirely, on studies of US workers, and focus on accidental deaths. The workers studied are, on average, in their mid- to late-thirties and their average income varies from close to $10,000 to over $40,000 (in 1990 dollars), reflecting the differing populations and job categories addressed by each study. Almost all of the studies address job-related risks. The magnitude of the risks average from about one in one hundred thousand to about seven in ten thousand annually, and tend to cluster around one in ten thousand.

The studies vary in other ways (e.g., sample sizes used, characteristics of the underlying data, extent to which they adjust for potentially significant variables such as the availability of workers' compensation) that may affect both their quality and their suitability for use in environmental policy analysis. They also were designed to address a variety of different concerns, such as investigating the effects of gender, unionization, job type, location, and/or risk perceptions on VSL estimates. The nature of these concerns, in turn, affected the data incorporated into the study design and the variables used in the statistical analysis.

The approach developed for the Clean Air Act analysis, based on these twenty-six VSL estimates, was ultimately incorporated into the EPA's *Guidelines for Preparing Economic Analysis* (EPA 2000a). For many years, the central tendency (or mean) VSL estimate used in EPA regulatory analyses was derived from this range of values, adjusted as needed for inflation.

Recently, researchers have completed several analyses that use statistical methods to combine data from various VSL studies (often called "meta-analyses"). These studies include Mrozek and Taylor (2002), Kochi et al. (2006), and Viscusi and Aldy (2003), each of which uses a somewhat different methodology and reports different ranges of best estimates. For example, Mrozek and Taylor (2002) report a mean VSL of $2.6 million (1998 dollars)

for the average worker, Kochi et al. (2006) report a mean of $5.4 million (2000 dollars) with a standard deviation of $2.4 million, and Viscusi and Aldy (2003) report means ranging from $5.5 million to $7.6 million (2000 dollars) depending on the model specification used.

The EPA has begun to use these meta-analysis results when assessing the impacts of its air pollution rules (e.g., EPA 2004, 2005a) while continuing to rely on the twenty-six studies for other rules, such as those addressing drinking water (e.g., EPA 2005b). When applying the meta-analysis results, the EPA uses a range of estimates, anchored at $1 million (near the lower end of the range from Mrozek and Taylor) and $10 million (near the upper end of the range from Viscusi and Aldy), with a mean of $5.5 million (1999 dollars).

This approach results, in part, from the advice of a special panel of the EPA's Science Advisory Board (Cameron et al. 2004). In its review of the plans for the EPA's *Second Prospective Analysis* of the Clean Air Act, this panel suggested that the agency focus primarily on the results of Viscusi and Aldy (2003) meta-analysis and also incorporate lessons learned from the other studies. This approach is also consistent with the range reported in the OMB's *Circular A-4* discussion of values to be used in regulatory analysis.

Over time, various aspects of the EPA's approach have been reviewed by independent committees of its Science Advisory Board (e.g., Cropper 2001; Schmalensee 1993; Stavins 1999, 2000), and have been subject to extensive public comment. Most of these reviews suggested that additional research is needed to refine the base VSL estimates, but did not provide a specific alternative that could be applied in the near term. In addition, many of the reviews discussed the differences between the scenarios studied and the scenarios addressed by the EPA regulations, as described below.

The EPA's Adjustments for Scenario Differences

Throughout the development of the EPA's VSL estimates, the agency and its advisory panels have struggled with issues related to the differences among the scenarios being assessed. The populations and risks affected by the EPA's regulations differ in several important ways from those addressed by the studies (EPA 2000b; IEc 2001). As noted earlier, the twenty-six studies focus largely on the risks of accidents affecting middle-aged workers. In contrast, the EPA's policies affect premature mortality from illnesses that may be spread more widely throughout the population or concentrated in younger or older age groups. The populations may differ not only in their age, but also in their income, health status, and/or degree of risk aversion. The types of health risks may differ in their timing or duration, in their voluntariness or controllability, and in the extent to which they are dreaded. For example, air pollution controls will not immediately reverse all the effects of a lifetime of exposure, and many pollution-related illnesses (such as cancers) may be particularly dreaded because they include a period of morbidity prior to death.

Because only limited data are available on the effects of these varying scenarios, it is not possible to modify the VSL estimates from the research literature to reflect most of these differences. The EPA has adjusted its base estimates for income growth and for any delays in the incidence of risk reductions (often referred to as cessation lags) in most regulatory analyses; adjustments for other factors (in either the base case or sensitivity analysis) have

been made in only a few cases. The effects of these other factors are instead described qualitatively.

This approach is consistent with the advice of several EPA advisory panels. For example, two Science Advisory Board groups (Cropper 2001; Stavins 2000) did not support an adjustment for voluntariness and controllability included in sensitivity analysis of the benefits of the EPA's rule governing arsenic in drinking water.[2] More generally, the Science Advisory Board's Environmental Economics Advisory Committee (Stavins 2000) suggested that the available evidence supported quantitative adjustments only for income growth and cessation lag when valuing cancer-related fatalities.

With regard to age adjustments, the position of the EPA's advisory panels has changed over time. In response to the concerns about the equitable treatment of younger and older individuals, the EPA has discontinued its use of VSLY estimates as well as VSL age adjustments in recent analyses. The following sections discuss in more detail the issues related to VSL adjustments for age, income, and time lags.

Age Adjustments

As noted in the earlier discussion of the senior discount debate and its effect on the OMB's guidance, age adjustments have been a particularly contentious issue. While the average age of the population included in the VSL studies is in the mid- to late-thirties, some EPA regulations have disproportionate effects on different age groups. Most significantly, for air rules addressing particulate matter, roughly 80 percent of the reduction in premature mortality may occur among individuals over age sixty-five (EPA 1999a).

As the result of its own research and negotiations with the OMB during the regulatory review process, the EPA included sensitivity analyses of the effects of age adjustments (adjusting VSL and/or applying VSLY estimates) in several of its reports prior to the development of *Circular A-4*. The Tier 2 rule governing air emissions from motor vehicles (EPA 1999b) is one example of a regulatory analysis that includes age adjustments in sensitivity analysis.[3]

While certain of the older EPA analyses report VSLY estimates, research suggests that such calculations are overly simplistic. In particular, some studies have indicated that there is an inverse U shaped relationship between age and the VSL, which peaks in middle age (e.g., Jones-Lee 1989; Jones-Lee et al. 1993). Another study (Alberini et al. 2004a) found that US respondents over age seventy were willing to pay about 20 percent less than individuals aged forty to seventy to reduce their risk of premature mortality; however, this result was not statistically significant.

The EPA has used these studies to adjust VSL estimates in illustrative analyses. For example, for the heavy-duty diesel rule (EPA 2000c), the EPA used VSL age adjustments

[2]One Science Advisory Board group (Cropper 2001) recommended adding medical treatment costs to VSL estimates to reflect the impacts of morbidity prior to death; however, this adjustment has been rarely applied.

[3]Several other EPA policy analyses (not technically subject to *Circular A-4* because they are not regulatory proposals) also include these adjustments in sensitivity analysis, such as the retrospective assessment of the Clean Air Act (EPA 1997), the prospective assessment of the Clean Air Act (EPA 1999a), and the Clear Skies legislative proposals (EPA 2003b).

based on Jones-Lee (1989) and Jones-Lee et al. (1993) in sensitivity analysis, which reduced its primary benefits estimate by 10 or 40 percent, depending on the adjustment factor applied. In a sensitivity analysis for regulations addressing emissions from large spark ignition engines (EPA 2002), the agency used a more complicated approach that reflected initial results from the work of Alberini et al. (2004a) as well as the adjustment factor from Jones-Lee (1989). In this case, the EPA combined the age adjustments with a lower base VSL ($3.7 million instead of $6.1 million) that included only the five contingent valuation studies (see Appendix Table A1). As a result, the age-adjusted values for both younger and older individuals were substantially lower than the base estimates for all age groups.

As discussed above, because these and other approaches to age adjustments have raised serious concerns about the equitable treatment of younger and older individuals in policy decisions, the EPA has not used VSLY estimates or VSL age adjustments in its more recent analyses. This evolution of the EPA's practices is consistent with the advice of its advisory panels. For example, a 1993 review of the EPA's approach to the retrospective analysis of the Clean Air Act suggested that the VSL should be adjusted to reflect the number of life years saved (Schmalensee 1993). A similar suggestion was contained in a 1999 review of the EPA's guidelines for economic analysis, which recommended that age adjustments be included in sensitivity analysis (Stavins 1999). However, a subsequent panel reviewing the valuation of cancer-related fatalities indicated that, rather than relying on simple VSLY calculations, "the theoretically appropriate method is to calculate WTP for individuals whose ages correspond to those of the affected population" and "urges that more research also be conducted on this topic" rather than recommending the implementation of adjustments based on currently available studies (Stavins 2000, p. 8). The Environmental Economics Advisory Committee of the EPA's Science Advisory Board is now revisiting this issue, and is expected to recommend against the use of VSLY estimates.

Valuing risks to children raises additional concerns. For example, measuring a child's own WTP for his or her health risk reductions is problematic—it is more feasible to measure adult WTP for reducing risks to children. However, parents' values for their children may be higher than their WTP to reduce their own risks and may differ from societal values (see EPA 2003a). Because of the lack of relevant research, the EPA and other agencies generally use the same values for both adults and children. The OMB's *Circular A-4* indicates that the values for children should be at least as large as the values used for adults.

Income Adjustments

Income has a clear and measurable effect on the VSL: as income increases, WTP for risk reductions usually increases. While this effect could be measured both cross-sectionally (across individuals or subpopulations) and longitudinally (over time), most studies are cross-sectional. However, using different VSL estimates for individuals with different incomes is controversial and has raised issues about the equitable treatment of richer and poorer segments of the population in policy decisions. Thus the EPA does not make cross-sectional adjustments in its analyses.

Instead, the EPA uses the cross-sectional data to estimate the longitudinal change in VSL likely to occur as real per capita income (measured by gross domestic product [GDP]) changes over time. This adjustment involves estimating the percentage change in the VSL

that is associated with a 1 percent change in income (i.e., its income elasticity). Because most studies suggest that this elasticity is less than one, several EPA analyses have used a distribution of income elasticity estimates with a mode of 0.40 and endpoints at 0.08 and 1.00 (EPA 1999a). The EPA typically first adjusts the VSL estimates to a common base year (often 1990), and then applies the adjustment for real income growth over the future time period considered in the analysis. The same estimates of income-adjusted VSL are then used for all members of the population affected by the rulemaking.

Time Lag Adjustments

Another difference between the accidental deaths addressed by most VSL studies and the impacts of some environmental contaminants is the possibility of a time lag between changes in exposure and changes in premature mortality. This lag is often referred to as "latency" when the results of exposure are not immediately manifest. However, in its analyses, the EPA is usually concerned instead with the "cessation lag," which refers to the delay between decreased exposure and achievement of the full reduction in health risks.

The most extensive research on cessation lag relevant to the EPA's regulations addresses cigarette smoking, and suggests that the duration of this lag may differ significantly from the latency period. For example, an expert panel that reviewed the EPA's rule for arsenic levels in drinking water noted that smoking studies suggest that "the latency between initiation of exposure and an increase in lung cancer risk is approximately 20 years. However, after cessation of exposure, risk for lung cancer begins to decline rather quickly" (Cropper 2001, p. 5). The EPA's subsequent analysis (reported in EPA 2005b) suggested that 80 percent of the lung cancer benefits were likely to accrue prior to twenty years after cessation of exposure.

Until recently, there was little research that directly addressed the effects of such lags on VSL estimates. Thus, for many years, the EPA used simple discounting to account for this effect. For example, if the pollution reduction occurred in the current year but a portion of the risk reduction occurred five years later, then the VSL would be discounted to reflect the five-year delay, using the same discount rate as applied elsewhere in the analysis.[4] Recent studies would appear to support the use of discounted values for delayed impacts (e.g., Alberini et al. 2004b; Hammitt and Liu 2004), although the estimates of the extent of the discount vary.

The EPA is now revising its *Guidelines for Preparing Economic Analysis* (2000a), as well as updating its approach for its next prospective analysis of the Clean Air Act, and has asked the Environmental Economics Advisory Committee of its Science Advisory Board to further assess these issues. To support this effort, the EPA completed a review of the VSL literature (Dockins et al. 2004) that summarized recent studies and meta-analyses. The EPA also funded research on the robustness of estimates from wage-risk and contingent valuation studies (Alberini 2004; Black, Galdo, and Lin 2003), as well as from studies of averting behavior (i.e., measures that individuals undertake to avoid or mitigate risks, such as the use of seat belts) (Blomquist 2004). The EPA subsequently convened a group of statisticians to

[4] *Circular A-4* generally requires that agencies report the results using two alternate discount rates (3 and 7 percent) and also report the undiscounted values over time.

address the use of meta-analysis (EPA 2006) and conducted a review of the literature on the relationship between life expectancy and the VSL (Dockins et al. 2006). The committee's review is ongoing, and its final report on the use of meta-analysis and adjustments for life expectancy is expected sometime in 2007.

Approaches Used by Other Agencies

Other agencies promulgate fewer economically significant rules that require valuing the risk of premature mortality. Between October 2003 and September 2005, four agencies (in addition to the EPA) prepared final rules with quantified health and safety benefits that were reviewed by the OMB (OMB 2005, 2006). These agencies included the Food and Drug Administration (FDA) and the Centers for Medicare and Medicaid Services (CMS) in the Department of Health and Human Services (HHS), as well as the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) in the Department of Transportation (DOT). An earlier review, covering the period between January 2000 and June 2004, reported similar patterns in agency promulgation of major health and safety rules (Robinson 2004).

The HHS Agencies (the FDA and the CMS)

The FDA does not provide formal internal guidance for economic analysis, but it applies a similar approach across many of its rules. For premature mortality, the agency often uses a VSL estimate of $5 million, without specifying a dollar year, and occasionally provides alternative estimates using higher or lower values (see, e.g., FDA 2003, 2004, 2005). This estimate is roughly in the middle of the $1 million to $10 million range cited in *Circular A-4* (OMB 2003).

The FDA rarely adjusts its VSL estimates for scenario differences, although it has addressed cessation lag (e.g., in its trans-fat rule, FDA 2003), and added the cost of cancer treatment ($25,000) and an adjustment for psychological factors ($5,000) to the VSL for a rule on X-rays (FDA 2005). Thus, while its base VSL estimates are similar to those used by the EPA, the values ultimately applied by the FDA may be quite different because of the income growth and other adjustments made by the EPA. A few FDA analyses have presented alternative estimates of the value of mortality risk reductions using VSLY as well as VSL estimates (e.g., FDA 2003).

However, VSLY estimates are a key component of the FDA's approach for valuing nonfatal risk reductions. The FDA first assesses the quality-adjusted life year (QALY) gains associated with reducing the risk of each nonfatal health condition, and then uses VSLY estimates to value each QALY. The FDA next adds medical costs to these monetized QALYs to determine the total benefits per statistical case of illness averted (see Institute of Medicine 2006 for more information). The FDA follows this process primarily because of the scarcity of WTP estimates for the health effects of concern.

In recent analyses (e.g., FDA 2003, 2004, 2005), the FDA has applied VSLY values ranging from about $100,000 to $500,000 per life-year. The low end of this range is based on estimates occasionally used in the health economics literature (see FDA 2003), while the higher values are derived from its VSL estimates using the same simple VSLY approach as described earlier.

Another HHS agency, the CMS, develops few economically significant rules with health and safety impacts; most of its programs involve transfers (e.g., from taxpayers to Medicare and Medicaid recipients) and hence are not subject to the OMB requirements for regulatory analysis. In its immunization rule (CMS 2005), the CMS applies the same VSL estimate as the FDA ($5 million), noting that it is roughly the mid-point of the range of values suggested by the OMB.

The DOT Agencies (the NHTSA and the FMSCA)

Both the NHTSA and the FMCSA rely on the DOT-wide guidance for their base VSL estimates. The DOT currently recommends the use of a $3.0 million VSL—noting that this value is imprecise and should be used as "a guide for thoughtful decision-making" (DOT 2002, p. 1). Its approach is based largely on the results of Miller (1990), with adjustments for inflation and newer studies. Miller's 1990 estimates vary from those used by the EPA because he applies different criteria to determine which studies to include, and adjusts the results to address certain limitations of the studies. The DOT indicates that it continues to review the literature and consider whether changes to this value are needed (DOT 2002).

In contrast to the EPA and the HHS agencies, these DOT agencies primarily address injury-related accidental deaths rather than deaths from illness. Hence, the scenarios they assess are in some respects more similar to the scenarios addressed by available VSL studies. The DOT agencies do not, however, adjust their values for relevant scenario differences (such as changes in real income over time) but instead add on certain costs that may not be reflected in the VSL estimates.

Both the NHTSA and the FMCSA adjust the DOT's base VSL estimate to reflect lost productivity and various types of expenditures, although the details of the adjustments vary slightly. Under the assumption that the VSL estimates include the expected loss of after-tax wages and household production (i.e., unpaid work in the home), the agencies first subtract estimates of these productivity losses from the base VSL estimate. They then add updated estimates of crash-related losses in market and household productivity as well as other expenditures, such as those related to medical treatment, emergency services, insurance administration, workplace disruption, and litigation (NHTSA 2002, Zaloshnja and Miller 2002). After these adjustments, the per victim value for fatal injuries becomes approximately $2.7 million to $3.3 million (depending on the type of crash) excluding property damage (2000 dollars). Each agency recalculates these adjusted estimates periodically and applies the results across subsequent analyses (see, e.g., FMCSA 2005, NHTSA 2005). In recent assessments, these agencies also include sensitivity analyses using higher values.

Similar to the FDA, these DOT agencies use VSLY estimates to determine the monetary value of QALY gains when addressing nonfatal (rather than fatal) risk reductions. However, the details of their approaches differ substantially, as described in Robinson (2004).

Summary and Conclusions

Current OMB guidance suggests that VSL estimates range from about $1 million to $10 million. Review of agency practices suggests that they generally use values that fall within this range. For example, the central tendency of the range of twenty-six estimates used in

Appendix Table A1 Selected characteristics of VSL studies used by the EPA (1990 dollars)

Study	Mean VSL estimate	Population studied	Valuation method	Average age of sample	Average income of sample	Type of risk	Mean risk
Kniesner and Leeth (1991)	$0.6 million	US manufacturing workers	Wage-risk	37 years	$26,226	Job-related	40/100,000
Smith and Gilbert (1984), based on Smith (1983)	$0.7 million	US metropolitan area workers	Wage-risk	NR	NR	Job-related	NR
Dillingham (1985)	$0.9 million	US workers	Wage-risk	36 years	$20,848	Job-related	10/100,000
Butler (1983)	$1.1 million	S. Carolina workers	Wage-risk	NR	NR	Job-related	5/100,000
Miller and Guria (1991)	$1.2 million	New Zealand residents	Contingent valuation	NR	NR	Road safety	NR
Moore and Viscusi (1988)	$2.5 million	US workers	Wage-risk	37 years	$19,444	Job-related	5/100,000
Viscusi, Magat, and Huber (1991)	$2.7 million	US residents	Contingent valuation	33 years	$43,771	Auto accidents	1/100,000
Marin and Psacharopoulos (1982)	$2.8 million	UK workers	Wage-risk	NR	$11,287	Job-related	10/100,000
Gegax, Gerking, and Schulze (1991)	$3.3 million	US workers	Contingent valuation	NR	NR	Job-related	70/100,000
Kneisner and Leeth (1991)	$3.3 million	Australian manufacturing workers	Wage-risk	NR	$18,177	Job-related	10/100,000
Gerking, de Haan, and Schulze (1988)	$3.4 million	US workers	Contingent valuation	NR	NR	Job-related	NR
Cousineau, Lacroix, and Girard (1992)	$3.6 million	Canadian workers	Wage-risk	NR	NR	Job-related	1/100,000
Jones-Lee (1989)	$3.8 million	UK residents	Contingent valuation	NR	NR	Auto accidents	NR
Dillingham (1985)	$3.9 million	US workers	Wage-risk	36 years	$20,848	Job-related	8/100,000
Viscusi (1978, 1979)	$4.1 million	US workers	Wage-risk	40 years	$24,834	Job-related	10/100,000
Smith (1976)	$4.6 million	US workers	Wage-risk	NR	NR	Job-related	10/100,000
Smith (1983)	$4.7 million	US workers	Wage-risk	NR	NR	Job-related	NR
Olson (1981)	$5.2 million	US workers	Wage-risk	37 years	NR	Job-related	10/100,000
Viscusi (1981)	$6.5 million	US workers	Wage-risk	NR	$17,640	Job-related	10/100,000
Smith (1974)	$7.2 million	US workers	Wage-risk	NR	$22,640	Job-related	NR
Moore and Viscusi (1988)	$7.3 million	US workers	Wage-risk	37 years	$19,444	Job-related	8/100,000
Kniesner and Leeth (1991)	$7.6 million	Japanese manufacturing workers	Wage-risk	NR	$34,989	Job-related	3/100,000
Herzog and Schlottmann (1990)	$9.1 million	US manufacturing workers	Wage-risk	NR	NR	Job-related	NR
Leigh and Folson (1984)	$9.7 million	US workers	Wage-risk	NR	$27,693	Job-related	10/100,000
Leigh (1987)	$10.4 million	US workers	Wage-risk	NR	NR	Job-related	NR
Garen (1988)	$13.5 million	US workers	Wage-risk	NR	NR	Job-related	NR

Sources: Derived from EPA (1997), table I-1, and Industrial Economics Incorporated (2001), exhibit 4-2. Average income and risk level are based on Viscusi (1993), tables 2 and 6, and additional review of the individual studies.

Notes: 1990 dollars. "NR" indicates "not reported;" however, many of these studies are based on data sources that are similar to those for which these variables are reported.

many EPA analyses is $7.2 million (2005 dollars), while the mean EPA estimate based on recent meta-analyses is $5.5 million (1999 dollars). The FDA generally uses an estimate near the middle of the range ($5 million, no dollar year reported), while the DOT has consistently applied a lower value ($3 million in recent guidance).

The EPA adjusts its base VSL estimates to reflect income growth over time and any time lags between the reduction in exposure and the reduction in incidence. In contrast, the FDA adjusts for these differences infrequently. The DOT agencies do not make these adjustments, but add other expenditures to VSL estimates. Adjustments for age have been a particularly contentious area, and the EPA has discontinued the practice of including these adjustments in sensitivity analyses in response to concerns about the equitable treatment of younger and older individuals in policy analysis.

This review leads to several conclusions. First, the value of reducing premature mortality risks has been relatively well studied. In contrast, analysis of the costs and benefits of major regulations requires that agencies address a number of other complex and difficult issues for which data may be more limited. For example, agencies may need to assess the risks to human health associated with contaminants whose effects are only partially understood, or determine the costs of industry compliance despite limited ability to foresee technological innovations. In comparison, the number of VSL studies is large and provides useful information on the possible range of values. However, more research is needed to address the specific scenarios reflected in federal regulations.

Second, experience with the debate over age adjustments suggests that it is difficult for agencies to ignore equity issues when valuing mortality risks. Economists often argue that benefit-cost analysis is best suited for assessing economic efficiency, and that it is preferable to address concerns related to equity and the distribution of impacts separately. While studies of individual WTP indicate that the VSL varies with age and income, using different VSL estimates for different segments of the population has led some observers to question the fairness of policy deliberations. As a result, federal agencies generally apply the same mean VSL estimates across all individuals potentially affected by their regulations—regardless of age, income, or other characteristics.

Third, the use of different VSL estimates across agencies could lead to different levels of investment in life-saving regulations if the quantified estimates of benefits and costs were the only factors considered by policy-makers. For example, if two agencies were each considering a regulation with identical costs and mortality risk impacts, the agency using the lower VSL estimate might select a less costly option. In theory, the risks addressed by different agencies could have different monetary values due to variation in the nature of the risks and the populations affected. In reality, the differences across agencies appear instead to reflect variation in their approaches to addressing limitations in the available VSL research.

Finally, it is difficult to determine how the choice of a VSL estimate influences regulatory decisions, in part because many decisions are made at the same time that the analysis is undergoing review and revision. Although regulatory decisions are rarely based solely on the results of economic analyses, the variation in values argues for careful assessment and presentation of the uncertainty in the VSL estimates used throughout the regulatory development process.

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Report to Congress On the Costs and Benefits of Federal Regulations

1998

Office of Management and Budget

Office of Information and Regulatory Affairs

REPORT TO CONGRESS
ON THE COSTS AND BENEFITS OF FEDERAL REGULATIONS

Introduction

The Office of Management and Budget issued its first report to Congress on the costs and benefits of Federal regulations in 1997. Section 625 of the Treasury and General Government Appropriations Act, 1998 (P.L. 105-61) directs OMB to issue a second regulatory accounting report. The requirements of the report are the same as those of last year, to include:

> "(1) estimates of the total annual costs and benefits of Federal regulatory programs, including quantitative and non-quantitative measures of regulatory costs and benefits;
>
> "(2) estimates of the costs and benefits (including quantitative and non-quantitative measures) of each rule that is likely to have a gross annual effect on the economy of $100,000,000 or more in increased costs;
>
> "(3) an assessment of the direct and indirect impacts of Federal rules on the private sector, State and local government, and the Federal Government; and
>
> "(4) recommendations from the Director and a description of significant public comments to reform or eliminate any Federal regulatory program or program element that is inefficient, ineffective, or is not a sound use of the Nation's resources."

Section 625(b) requires the Director of OMB to provide public notice and an opportunity to comment on the draft report before it is submitted to Congress. The draft report was published in the *Federal Register* on August 17, 1998 with a 30 day comment period. However, as a result of requests from both the public and Members of Congress, we extended the comment period an additional 30 days to October 16, 1998, and established, after discussion with congressional staff, a new schedule for final publication.

As we noted in the 1997 report, there is not yet a professional consensus on methods that would permit a complete, consistent and accounting of total costs and benefits of Federal regulation. The 1997 report was our effort to begin an incremental process which we believe will lead to improved information on the effects of regulations, and will help solve the many methodological problems associated with this exercise. This year's report builds on last year's work. In particular, we have additional data to supplement our discussion of the aggregate costs and benefits of regulation and expand our database of costs and benefits of individual, major rules from one year (1997) to three years (1996 to 1998). In addition, we have more experience in dealing with the methodological problems.

One fact has not changed since the first report. There are still enormous data gaps in the information available on regulatory benefits and costs. Although accurate data is still sparse and agreed-upon methods for estimating many effects are still lacking, we have made significant progress in improving these estimates, especially for the major rules of the last three years.

As we stated last year, explicitly quantifying and monetizing benefits and costs significantly enhances our ability to compare alternative approaches to achieving regulatory goals, ultimately producing more benefits with fewer costs. President Clinton's Executive Order 12866, "Regulatory Planning and Review," recognizes and incorporates this principle, requiring agencies to quantify both costs and benefits to the best of their ability and to the extent permitted by law. We continue to recognize that significant regulatory costs and benefits may not be quantifiable, but may have to be described in qualitative terms. All information, both qualitative and quantitative, contributes to our understanding of the effects of regulation.

This report presents new information on both the total costs and benefits of regulation and the costs and benefits of major individual regulations. We hope to continue this important dialogue to improve our knowledge about the effects of regulation on the public, the economy, and American society.

Before submitting this report to Congress, we provided the public with notice and an opportunity to comment on this report as required by Section 625(b). We received 35 comments from representatives of industry and public interest groups, Federal agencies, and individuals. Favorable comments on the second report discussed the various improvements we made over the 1997 report. In particular, these include greater disaggregation of categories for the aggregate estimates, a significant increase in the number of estimates of costs and benefits for major rules, the inclusion of rules from independent agencies, monetizing the costs and benefits of major rules where agencies had been unable to do so, comparing retrospective estimates of costs and benefits with prospective estimates for a set of rules, and including a proposal to restructure the electricity generation sector.

Commenters also provided suggestions on how to improve the report. Prominent among these suggestions are that we should recommend reforming or eliminating additional Federal regulatory programs or program elements and use our own best judgements of the costs and benefits of Federal regulations, relying less on agency estimates. We have followed these suggestions. In Chapter IV, we present ten additional recommendations for reforming or eliminating additional Federal regulatory programs. We also discuss in greater detail in the Appendix our efforts to be responsive to these suggestions as well as the many others that we received. In some cases, we have modified the report to incorporate the suggested changes, in others we have made plans to include them in our next report that is required by the Regulatory Accounting Amendment contained in Section 638 of H.R. 4328, The Omnibus Consolidated and Emergency Supplemental Appropriations Act, FY 1999 (P.L. 105-277), and in still others we explain why we do not plan to adopt the suggestions.

In our August 17, 1998, Notice published in the *Federal Register*, we asked for comments on all aspects of the draft report, but in particular asked for comments and suggestions pertaining to the following:

- The validity and reliability of our new estimates of the costs and benefits of regulations in the aggregate, as well as by regulatory program or program element;
- Our discussion of the methodological problems of estimating the costs and benefits of existing rules, e.g., the baseline and comparability problems and complications introduced by using prospective studies to evaluate existing programs;
- Our review of several case studies of the costs and benefits of existing regulations and the lessons we draw from them;
- Any additional studies that might provide reliable estimates or assessments of the annual costs and benefits, or direct and indirect effects on the private sector, State and local government, and the Federal Government, of regulation in the aggregate or of the individual regulations that we discuss;
- Our approach to estimating the costs and benefits of the individual regulations reviewed by OMB between April 1, 1995, and March 31, 1998, that we discuss; and;
- Programs or program elements on which there is objective and verifiable information that would lead to a conclusion that such programs are inefficient or ineffective and should be eliminated or reformed.

Also, Congress specifically required that the report provide ". . . a description of significant public comments to reform or eliminate any Federal regulatory program or program element that is inefficient, ineffective, or is not a sound use of the Nation's resources." We have summarized the comments we received pursuant to the *Federal Register* Notice in the Appendix to this report. As noted above, we have incorporated the useful suggestions we gained from the comments to the extent possible.

The report is divided into four chapters and the Appendix. In accordance with Section 625(a)(1), Chapter I presents our best estimate of the total costs and benefits of Federal regulation. It builds on Chapter II of the 1997 report presenting updated and more detailed

estimates of the total annual costs and benefits of major Federal regulatory programs.[1] In particular, this year we present more categories of regulatory costs and benefits than last year and use our own estimates based on agency data of costs and benefits of individual rules reviewed by OMB over the last three years (April 1, 1995 to March 31, 1998) to update the aggregate estimates. We also chose this year to provide ranges of costs and benefits rather than point estimates to emphasize the uncertainty embodied in the estimates.

As we did last year, we use the study by Hahn and Hird (1991) for the costs and benefits of regulations as of 1988, supplemented by an Environmental Protection Agency (EPA) Cost of a Clean Environment report to Congress (1990). We also use a new (1997) retrospective EPA report to Congress (The Benefits and Costs of the Clean Air Act, 1970 to 1990). The new EPA report accounts for broadening the upper end of the range in the benefit estimates for this year's report. It reflects the findings of EPA as peer reviewed by the EPA's Science Advisory Board. An interagency review was not completed, however, due to a court-ordered deadline for publication.[2]

Because there are no studies comparable to the Hahn and Hird or the EPA retrospective studies for the regulations issued after 1988[3], we use information about costs and benefits from agency prospective regulatory impact analyses (RIAs) to account for the major regulations that have been issued since 1988. In almost all cases, the RIAs have been subject to notice and comment and have been reviewed by OMB. This year we have systematically started to improve the consistency of the agency estimates and to show monetized estimates of benefits where appropriate and feasible. We have completed this analysis for the last three years and plan to complete additional years in the future.

The new estimates range from $170 billion to $230 billion in annual costs and $260 billion to about $3.5 trillion in annual benefits for social, i.e., health, safety, and environmental

[1] Chapter I of the 1997 report discussed the role of economic analysis in regulatory reform. We discussed the growth and nature of regulation, the development of the U.S. regulatory analysis and review program and the basic principles that should be used in assessing regulatory costs and benefits. We did not repeat that discussion this year but it is still useful for understanding the context of this year's report. (See OMB 1997 or http://www.whitehouse.gov/WH/EOP/OMB/html/rcongress.htm).

[2] See the discussion below in the text and in footnote 14.

[3] EPA's Clean Air Act report covers effects through 1990. However, for the annual estimates that appear in Table 1 and in the text, we have, in consultation with EPA staff, adjusted EPA's estimates to reflect only effects as of 1988.

regulation. Using the ranges to reflect the substantial uncertainty in the estimates, quantified (and monetized) net benefits could be as low as $30 billion, or as high as $3.3 trillion. The main reason why these estimates are different from last year, especially on the upper end of the range of benefits, is that we have incorporated retrospective estimates from a recent EPA report on the benefits and costs of the Clean Air Act. This report, discussed in detail in Chapter I, estimates the benefits of the Clean Air Act at up to $3.2 trillion. Three new regulations also included in the estimates (EPA's revised particulate matter and ozone primary National Ambient Air Quality Standards and OSHA's respirator rule) are estimated (using midpoints) to provide approximately $35 billion in benefits per year. While this information is useful, we still believe that the limitations of these estimates for use in making recommendations about reforming or eliminating regulatory programs are severe. Aggregate estimates of the costs and benefits of regulation offer little guidance on how to improve the efficiency, effectiveness, or soundness of the existing body of regulations.

Chapter I also discusses the impacts of other types of regulation and regulatory-like activities and reviews several estimates of the aggregate costs of regulation as well as several retrospective case studies. Estimates of the impacts of economic efficiency losses, disclosure regulation, economic transfers, tax compliance costs, Federal on-budget regulatory expenditures, and the possible indirect effects of regulation on the economy as directed by Section 625(a)(3) are also presented and discussed.

In fulfillment of Section 625(a)(2), Chapter II provides data from the agencies on the costs and benefits of each of the economically significant regulations reviewed by OMB under Executive Order 12866 over the period from April 1, 1997 to March 31, 1998. The data were developed by the agencies as required by the Executive order. For the most part, these data were subject to notice and public comment and reviewed by OMB. We also examined the reports on major rules that GAO provides to Congress for the independent agencies not subject to Executive Order 12866; however, these generally were not of sufficient detail to provide much useful information for the purposes of this report. Finally, this Chapter also highlights examples where agencies have done a particularly exemplary job of following the guidance in the *Best Practices*[4] document, which is on our web site at http://www.whitehouse.gov/WH/EOP/OMB/html/miscdoc/riaguide.html.

Chapter III provides estimates of the costs and benefits for the economically significant/major rules reviewed by OMB between April 1, 1995, and March 31, 1998, for which we were able to estimate costs and benefits. The estimates that we present in Chapter III for

[4] OMB published in 1996 a document that describes "*Best Practices*" for preparing the economic analysis called for by Executive Order 12866 for significant regulatory actions. This document represents the culmination of a two-year effort by an interagency group to review the state of the art for economic analyses required by the Executive order.

regulations issued during these three years are either straightforward agency estimates, or estimates that we calculated using a consistent methodology and value estimates used by the agencies for other regulations or in some cases found in the academic literature. We estimate annual costs of major rules for these three years to be about $28 billion while annual benefits range from $30 to $97 billion.

Chapter IV discusses how we implemented last year's recommendations aimed at further developing the information, methodologies, and analyses necessary for improving the efficiency, effectiveness, and soundness of regulatory programs and program elements as required by Section 625(a)(4). We discuss how the agencies and OMB worked together to improve the quality of the data and analysis found in the economic impact studies submitted to OMB under Executive Order 12866, and in particular how we promoted the use of the *Best Practices* guidance document. Finally, also in fulfillment of Section 625(a) (4), we present a discussion of the Administration's proposal to restructure and deregulate the electricity sector and a summary of a number of initiatives to reform regulatory programs based on the Regulatory Plan published in the *Federal Register* on November 9, 1998.

Finally, the Appendix summarizes and discusses the comments we received from the *Federal Register* Notice.

Chapter I: Estimating the Total Annual Costs and Benefits of Federal Regulatory Programs

I. Overview

By using new data from agency regulatory impact analyses that accompany regulations, this chapter builds on Chapter II of the 1997 report (OMB 1997) to present updated and more detailed estimates of the total annual costs and benefits of Federal regulatory programs. We also discuss and present quantitative estimates where available of indirect impacts and other effects of regulation and related Government policies. Finally, several retrospective studies of specific regulatory programs are reviewed to gain insight on how the actual costs and benefits of regulations may differ from the effects predicted prior to regulation.

We respond to the comments we received on the 1997 report in several ways. First, we present more details by regulatory program and build on agency analyses to monetize benefits estimates. Second, we review the analyses from independent agencies and present more systematic data on the costs and benefits of economic regulation, tax compliance costs, transfers, Federal regulatory expenditures, and indirect impacts. Finally, our review of several important retrospective studies responds to important methodological issues raised regarding the use of prospective studies to estimate the costs and benefits of existing regulations.

A. Estimation Problems

Before proceeding with our new estimates, we reiterate and reemphasize the methodological concerns and caveats that were discussed in the 1997 report. These concerns remain of critical importance. It remains difficult, if not impossible, to estimate the actual total costs and benefits of all existing Federal regulations with any degree of precision. There is a variety of estimation problems for both individual estimates and aggregate estimates.

In order to estimate the impact of regulations on society and the economy, one has to determine how things would have been if the regulation had not been issued. In other words, what is the baseline against which costs and benefits should be measured? With respect to estimating total costs and benefits of all Federal regulations, the baseline problem has several dimensions. First, what would have happened in the absence of regulation can only be an educated guess since it never happened. Furthermore, the greater the regulatory change, the more problematic the exercise. For example, the techniques of applied welfare economics, upon which benefit-cost analysis is based, hold only for marginal changes in economic activities. The larger the changes, the less sure we are of the predictions. In other words, we can in general be more confident in our estimates of the costs and benefits of a small change in the level of automobile emissions permitted than in the costs and benefits of all Clean Air Act regulations and still more confident than in estimates of the costs and benefits of all regulations issued by the Federal Government since the early 1900s. If we use as a baseline a world with no regulation, one can reasonably argue that the benefits of regulation must clearly swamp any likely cost.

Even disregarding the problem of modeling large changes, there are significant difficulties in determining the counterfactual or baseline for individual regulations that one could begin to aggregate. One can survey firms and other regulated entities on their expected compliance costs either prospectively, before the regulation is implemented, or retrospectively, after the regulation has gone into effect. For both types of studies, the problem of potential estimation bias must be kept in mind since regulators and regulatees may have different interests in the outcomes. The problem of bias is potentially greater for prospective studies because both the baseline and the regulatory effects must be predicted while for retrospective studies only the baseline or counterfactual must be predicted. In the ordinary course, therefore, the best estimates of the costs and benefits of regulation are likely to be retrospective studies done by individuals who do not have vested interests, but do have reputations as objective analysts to uphold.

To make matters even more complicated, a third type of study is actually needed before recommendations can be made to eliminate or modify regulatory programs. That is a hybrid study somewhere between pure prospective and pure retrospective. The ideal hybrid study would be a retrospective study of the existing regulation with prospectively estimated costs and benefits of eliminating or modifying it. A hybrid study is needed because "sunk costs," such as specialized capital costs and the cost of changing procedures already in place, make the cost savings from eliminating regulation less than the cost of complying with those regulations. Furthermore, on the benefit side there appears to exist an asymmetry between giving someone a benefit and taking it away. Studies have shown that people are willing to pay less for a benefit than what they are willing to accept in return for its loss. In other words, once people have attained safer jobs or cars, or cleaner air or water, they appear to value such benefits once attained more than before they had attained them. Very few studies of health, safety, and environmental regulation have attempted to estimate the actual cost savings and benefit losses that would result from reducing or eliminating an existing regulation.[5]

Further, virtually all of the studies of the costs of regulation produced to date measure the expenditures of firms required by regulation, whereas the cost to society of regulation should be measured by the change in consumer and producer "surplus" associated with the regulation and with any price and/or income changes that may result (Cropper and Oates 1992). At one extreme, ignoring the consumer surplus loss produced by a ban on the sale of a product understates costs to society because although no compliance expenditures are required, consumers can no longer buy the product. At the other extreme, calculating compliance

[5] Note that the problem of bias may be the greatest in this case because often both the regulators and the regulatees will prefer the status quo, i.e., regulation. This appears to be the lesson from the Occupational Health and Safety Administration's (OSHA) reconsideration of the cotton dust standard during the Reagan Administration. After opposing the regulation at the proposal stage during the Carter Administration, the industry did not support the Reagan Administration's proposal to withdraw it. (See Viscusi 1992).

expenditures based on pre-regulation output overstates costs because if the firm raises prices to cover compliance costs, consumers will shift to other products and thereby reduce their welfare losses (Cropper and Oats 1992, p. 722).

Another problem is the fact that many studies that we rely on for cost and benefit estimates are dated. Over time the dynamic nature of the economy may affect the estimation of both benefits and costs. Technological improvements are often cited as the reason that predicted costs of compliance often turn out to be less than actual costs (Office of Technology Assessment 1995). Less well noted, however, is that technological progress also takes place on the benefit side. For example, medical progress can reduce the future benefits estimated for health, safety and environmental regulations, just as productivity improvements in manufacturing reduce the costs of compliance of some regulations. New drugs or medical procedures can reduce the benefits of regulations aimed at reducing exposure to certain harmful agents such as an infectious disease. Regulations aimed at increasing the energy efficiency of consumer products or buildings may see their expected benefits reduced by new technology that reduces the cost of producing energy. Furthermore, productivity improvements lead directly to higher incomes, which lead people to demand better health and more safety. Business responds to these demands by providing safer products and workplaces, even in the absence of regulation. Individuals with rising incomes may also purchase or donate land to nature conservancies to provide ecological benefits. Yet, as on the cost side, the baseline that is used is almost always the *status quo*, rather than what is likely to be true in the future.

It is often difficult to attribute changes in behavior to specific Federal regulations apart from the many other motivating factors. In addition to overlapping Federal regulations, often from different agencies, e.g., environmental issues may be regulated by the Environmental Protection Agency (EPA), the Department of Agriculture (USDA), the Department of Energy (DOE), the Department of the Interior (DOI), the Department of Commerce (DOC) and the Department of Transportation (DOT), state and local regulations also require compliance. The tort system, voluntary standards organizations, and public pressure also cause firms to provide a certain degree of public protection in the absence of Federal regulation. As the General Accounting Office (GAO) points out, determining how much of the costs and benefits of these activities to attribute solely to Federal regulation is a difficult undertaking (GAO 1996).

Adding to the complexity, the degree to which these other factors cause firms and other regulated entities to provide safe and healthful products and workplaces and engage in environmentally sound practices changes over time, generally increasing with increasing *per capita* incomes and knowledge about cause and effect. Thus, although the National Highway Traffic Safety Administration (NHTSA) has significantly increased the safety of automobiles, it is not likely that if the agency's regulations were eliminated the automobile companies would discontinue all the safety features that have been mandated. Consumers are demanding safer cars and automobile companies are concerned about product liability. This same phenomenon is taking place in the environmental area. Environmentally responsible behavior is good for the bottom line. Over time, this "rising baseline" phenomenon, if correct, should reduce the true

Chapter II: Estimates of Benefits and Costs of This Year's "Economically Significant" Rules

In this chapter, we examine the benefits and costs of "each rule that is likely to have a gross annual effect on the economy of $100,000,000 or more in increased costs," as required by section 645(a)(2). We have included in our review those final regulations on which OIRA concluded review during the 12-month period April 1, 1997, through March 31, 1998. This "regulatory year" is the same time period we chose for the 1997 report. We chose this time period to ensure that we covered a full year's regulatory actions as close as practicable to the date our report is due, given the need to compile and analyze data and publish the report for public comment. In addition, we thought it would be useful to adopt a time period close to that used for the annual OMB report required by the Unfunded Mandates Reform Act of 1995.

The statutory language categorizing the rules we are to consider for this report is somewhat different from the definition of "economically significant" in Executive Order 12866 (section 3(f)(1)). It also differs from similar statutory definitions in the Unfunded Mandates Reform Act and subtitle E of the Small Business Regulatory Enforcement Fairness Act of 1996 - - Congressional Review of Agency Rulemaking. Given these varying definitions, we interpreted section 645(a)(2) broadly to include all final rules promulgated by an Executive branch agency that meet any one of the following three measures:

- rules designated as "economically significant" under section 3(f)(1) of Executive Order 12866
- rules designated as "major" under 5 U.S.C. 804(2) (Congressional Review Act)
- rules designated as meeting the threshold under title II of the Unfunded Mandates Reform Act (2 U.S.C. 1531 - 1538)

This year we also include a discussion of major rules issued by independent regulatory agencies, although we do not review these rules under Executive Order 12866. This discussion is based on data provided by these agencies to the General Accounting Office (GAO) under the Congressional Review Act.

During the regulatory year selected, OIRA reviewed 33 final rules that met the criteria noted above. Of these final rules HHS submitted 10; EPA nine; USDA five; DOI and DOE two each; DOL, DOT, DOJ, and VA one each. In addition three agencies, DOL, HHS, and Treasury, worked together to issue one common rule. These 33 rules represent about 14 percent of the 230 final rules reviewed by OIRA between April 1, 1997, and March 31, 1998, and less than one percent of the 4,720 final rule documents published in the *Federal Register* during this period. Nevertheless, because of their greater scale and scope, we believe that they represent the vast majority of the costs and benefits of new Federal regulations during this period.

I. Overview

As noted in Chapter I of the 1997 report, Executive Order 12866 "reaffirms the primacy of Federal agencies in the regulatory decision-making process" because agencies are given the legal authority and responsibility for rulemaking under both their organic statutes and certain process-oriented statutes, such as the Administrative Procedure Act, the Unfunded Mandates Reform Act, and the Small Business Regulatory Enforcement Fairness Act. The Executive order also reaffirms the legitimacy of centralized review generally and in particular review of the agencies' benefit-cost analyses that are to accompany their proposals. The Executive order recognizes that in some instances the consideration of benefits or costs is precluded by law. For example, the primary National Ambient Air Quality Standards under the Clean Air Act are to be health-based standards set by EPA solely on the basis of the scientific evidence. A variation is the Occupational Safety and Health Act, where health standards must be based on reducing significant risks to the extent doing so is economically and technologically feasible. However, the Executive order requires agencies to prepare and submit benefit-cost analyses even if those considerations are not a factor in the decision-making process. Again, it is the agencies that have the responsibility to prepare these analyses, and it is expected that OIRA will review (but not redo) this work. The costs and benefits identified may be attributable solely to the regulation in question, where the agency has substantial discretion, or they may in fact be attributable just as much to the act of Congress that they are implementing.

Reviewing for this report the benefit-cost analyses accompanying the 33 final rules listed in Table 9, we found, as we did last year, a wide variety in the type, form, and format of the data generated and used by the agencies. For example, agencies developed estimates of benefits, costs, and transfers that were sometimes monetized, sometimes quantified but not monetized, sometimes qualitative, and, most often, some combination of the three. Generally, the boundaries between these types of estimates are relatively well defined.

II. Benefits and Costs of Economically Significant/Major Final Rules (April 1997 to March 1998)

A. Social Regulation

Of the 33 rules reviewed by OIRA, 22 are regulations requiring substantial additional private expenditures and/or providing new social benefits.[32] (See Table 9). EPA issued nine of these rules; USDA three; HHS three; DOI and DOE two each; DOT and DOL one each; and HHS/DOL/Treasury jointly issued one rule. Agency estimates and discussion are presented in a

[32] The other 11 are "transfer" rules.

TABLE 9: SUMMARY OF AGENCY ESTIMATES FOR FINAL RULES 4/1/97 - 3/31/98
(As reported by the agency as of date of completion of OMB review)

AGENCY	RULE	BENEFITS	COSTS	OTHER INFORMATION
USDA	Environmental Quality Incentives Program (EQIP)	$2.41 billion (present value) 1997 - 2012	$1.65 billion (present value) 1997 - 2012	"The analysis estimates EQIP will have a beneficial impact on the adoption of conservation practices and, when installed or applied to technical standards, will increase net farm income. In addition, benefits would accrue to society for long-term productivity, maintenance of the resource base, non-point source pollution damage reductions, and wildlife enhancements. As a voluntary program, EQIP will not impose any obligation or burden upon agricultural producers that choose not to participate. The off-farm public benefits associated with on-farm conservation efforts are directly dependent upon the on-farm treatment needs and associated benefits. In the case of non-point source pollution from agricultural sources, for instance, public benefits are not achieved until private land user behavior changes and on-site conservation measures are applied. Some of the off-site benefits are attributable to improvements made to enhance freshwater and marine water quality and fish habitat, improved aquatic recreation opportunities, reduced sedimentation of reservoirs, streams, and drainage channels, and reduced flood damages. Additional benefits are from reduced pollution of surface and groundwater from agrochemical management, improvements in air quality by reducing wind erosion, and enhancements to wildlife habitat. EQIP encourages participants to adopt a comprehensive approach to solving natural resource and environmental concerns. Off-site benefits for pasture and rangeland and total benefits for animal waste management were not estimated due to unavailability of data." [62 FR 28258-9]

TABLE 9: SUMMARY OF AGENCY ESTIMATES FOR FINAL RULES 4/1/97 - 3/31/98
(As reported by the agency as of date of completion of OMB review)

AGENCY	RULE	BENEFITS	COSTS	OTHER INFORMATION
USDA	Importation of Pork from Sonora, Mexico	$0	$0	"Low-impact scenario: 67k hogs (0.02%), assuming supply elasticity = 0.15 and demand elasticity = -0.44. *Economic impacts on farrow-to-finish swine operators:* output decline=10k-17k hogs (≤0.02%); price decline= $0.05/hundredweight liveweight equivalent.; producers' receipts decline = $10.7 million/yr (0.02%) and are transferred to consumers (as consumer surplus) and Mexican producers (as producer surplus). *Economic impacts on live-hog dealers/transporters:* 86 trips. High-impact scenario: 134.1k hogs (0.02%), assuming supply elasticity = 0.075 and demand elasticity = -0.44. *Economic impacts on farrow-to-finish swine operators:* output decline=20k-34k hogs (≤0.02%); price decline= $0.11/hundredweight liveweight equivalent; producers' receipts decline= $24.5 million/yr (0.2%) and are transferred to consumers (as consumer surplus) and Mexican producers (as producer surplus). *Economic impacts on live-hog dealers/transporters:* 125 trips." [62 FR 25441-15443]

Chapter III: Estimates of Benefits and Costs of "Economically Significant" Rules, April 1995 - March 1998

The 1997 report recommended that OIRA continue to develop a data base on benefits and costs of major rules. This chapter seeks to respond to that recommendation by presenting the available benefit and cost estimates for individual rules from April 1, 1995 through March 31, 1998. The summary of agency estimates for final rules from the current year (April 1, 1997 to March 31, 1998) is presented in Chapter II, Table 9. The summary of agency estimates for final rules from the preceding two years (April 1, 1995 to March 31, 1997) is presented in Tables 17 and 18 in the Appendix.

In assembling agency estimates of benefits and costs, we have:

(1) applied a uniform format for the presentation of benefit and cost estimates in order to make agency estimates more closely comparable with each other, e.g., provided the benefit and cost streams over time, annualized benefit and cost estimates, etc., and

(2) monetized quantitative estimates where the agency has not done so, e.g., converted tons of pollutant per year to dollars.

The adoption of a format that allows the presentation of agency estimates so that they are more closely comparable also allows, at least for purposes of illustration, the aggregation of benefit and cost estimates across rules. At the same time we caution the reader that agencies have used different methodologies and valuations in quantifying and monetizing effects and we have attempted to be faithful to the respective agency approaches. In this chapter, we also aggregate benefit and cost estimates for those Federal rules with significant quantified benefit and cost estimates.

As noted in Chapters I and II, the substantial limitations of the available data on the benefits and costs for this set of rules raise significant obstacles to the development of a meaningful aggregate estimate of benefits and costs for even a single year's regulations. For example, in many cases agencies identified important benefits of their rules that were not quantifiable. In such cases, we necessarily omitted them from the monetized estimates we develop in this Chapter. To the extent that these benefits are substantial, the monetized estimates will understate the total value of the benefits. The discussion below addresses other limitations in the data and outlines the steps we have taken in an effort to overcome some of them.

I. Monetized Benefit and Cost Estimates for Individual Rules

First, we have only included in this Chapter those major rules with quantified estimates of benefits and costs. These include six rules from the 1995/96 period, 15 rules from the 1996/97 period, and 13 rules from 1997/98 period. We have excluded 13 rules without quantified

estimates of either benefits or costs. (See Table 11.) Six additional rules listed in Table 12 have also been excluded from further discussion because only quantified cost estimates were available and/or there were only relatively small benefit and cost estimates.

Second, for some of the remaining rules, agencies quantified estimates of significant effects, but did not assign a monetized value to these effects. Some of the quantified effects -- for example, small changes in the risk of premature death or serious injury -- are frequently identified as outcomes for a variety of rules. In a number of instances, though, agencies did assign monetized estimates to these outcomes.

Differences in valuation across rules are often critical, particularly in comparisons between and among individual rules or programs. Furthermore, the different approaches in the quantification and monetization of these effects across agencies result in an "apples and oranges" problem in aggregating estimates; in particular, where effects have been quantified, but not monetized, the different quantitative effects cannot be summed because they are not expressed in common units. In order to address this problem, this section takes the additional step of assigning a monetized value in order to provide a more consistent set of estimates in those cases where agencies only quantified significant effects. We have not, however, attempted to quantify or monetize any qualitative effects identified by agencies where the agency did not at least quantify them.

Agencies have, over the years, taken, and continue to take, several different approaches toward rules that affect small risks of premature death. In some cases, such as FDA's tobacco rule, agencies have quantified and monetized these effects in terms of "quality-adjusted statistical life years." In other cases, such as FRA's roadway worker protection rule, agencies have quantified and monetized these effects in terms of statistical lives. In still other cases, such as HHS's organ procurement rule and NHTSA's air bag depowering rule, agencies have quantified risks of death in terms of life-years or lives, but have not monetized them. Finally, in some cases, such as FDA's animal feed rule, the agency did not develop a quantified estimate of the rule's mortality effects.

Estimates for the value of a statistical life varied across agencies. For the tobacco rule, FDA estimated benefits based on a value of $2.5 million per statistical life. For the roadway worker rule, FRA used $2.7 million per statistical life. For the upper-bound estimates of EPA's ozone and PM NAAQS rules, the agency used $4.8 million per statistical life; and for its mammography rule, FDA also used $5 million per statistical life.[34] Similarly, agency estimates for the value of a statistical life-year have also varied. FDA used $116,500 per life-year for its

[34] The is a relatively rich body of academic literature on this subject. The methodologies used and the resulting estimates vary substantially across the academic studies. Based on this literature, agencies have developed estimates they believe are appropriate for their particular regulatory circumstances.

Table 11:
Major Rules Issued Between April 1, 1995 and March 31, 1998 Without Estimates of Either Benefits or Costs

USDA	1996 Farm Bill Farm Program Karnal Bunt, 1996-1997
HHS	Substances Prohibited in Animal Feed, 1997-1998
DOI	Migratory Bird Hunting (Early Season), 1995-1996 Migratory Bird Hunting (Fall Season), 1995-1996 Migratory Bird Hunting (Early Season), 1996-1997 Migratory Bird Hunting (Fall Season), 1996-1997 Migratory Bird Hunting (Early Season), 1997-1998 Migratory Bird Hunting (Fall Season), 1997-1998
EPA	Phase III Land Disposal Restrictions
DOT	Light Truck CAFE, 1995-1996 Light Truck CAFE, 1996-1997 Light Truck CAFE, 1997-1998

Table 12:
Small Estimates, Not Evaluated for Aggregate Estimate

USDA	Use of the Term "Fresh" for Poultry Labeling Importation of Sonoran Pork Importation of Argentine Beef
DOC	Encryption Items Transferred from U.S. Munitions List to the Commerce Control List
EPA	Lead-Based Paint Activities in Target Housing Toxic Release Inventory: Facility Expansion

tobacco rule; EPA used $120,000 per life-year to produce its lower-bound estimates of benefits in its ozone and PM NAAQS rules; FDA used $368,000 per life-year in its mammography rule. As a general matter, we have deferred to the individual agencies' judgment in this area. In cases where the agency both quantified and monetized fatality risks, we have made no adjustments to the agency's estimate.

In cases where the agency provided only a quantified estimate of fatality risk, but did not monetize it, we have monetized these estimates in order to convert these effects into a common unit. For example, in the case of HHS's organ donor rule, the agency estimated, but did not monetize, statistical life-years saved, although it discussed HHS' use of $116,500 per life-year in other contexts. We valued those life-years at $116,500 each. For NHTSA's air bag depowering rule, we used a value of $2.7 million per statistical life. In cases where agencies have not adopted estimates of the value of reducing these risks, we used estimates supported by the relevant academic literature. For DOL's respirator rule, for example, we used $5 million per statistical life.[35] As a practical matter, the aggregate benefit and cost estimates are relatively insensitive to the values we have assigned for these rules because the aggregate estimates are dominated by the FDA tobacco rule and EPA's rules revising the ozone and PM primary NAAQS. Finally, we did not attempt to quantify or monetize fatality risk reductions in cases where the agency did not at least quantify them.

II. Valuation Estimates for Other Regulatory Effects

The following is a brief discussion of our valuation estimates for other types of effects which agencies identified and quantified, but did not monetize.

- *Injury.* For the air bag depowering rule, we adopted the Department of Transportation approach of converting injuries to "equivalent fatalities." These ratios are based on DOT's estimates of the value individuals place on reducing the risk of injury of varying severity relative to that of reducing risk of death. For the two OSHA rules we used a ratio of 20 injuries per equivalent fatality.

- *Change in Gasoline Fuel Consumption.* We valued reduced gasoline consumption at $.80 per gallon pre-tax.

- *Reduction in Barrels of Crude Oil Spilled.* We valued each barrel prevented from being spilled at $2,000. This reflects double the sum of the most likely estimates of environmental damages plus cleanup costs contained in a recent published journal article (Brown and Savage, 1996).

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[35] As a result of a Supreme Court decision, OSHA does not conduct cost-benefit analysis or assign monetary values to human lives and suffering.

set to zero the value of agency benefits estimates that are not based on sound science (such as those for EPA's particulate matter rule) (22).

Another commenter suggested that OMB consider monetizing non-monetized costs (10). Two commenters suggested that OMB require the agencies to use the same assumptions for such parameters as discount rates and the value of a statistical life-year (18,22). Two other commenters suggested that OMB apply the same value of a statistical life across the different regulations (8,22). We will consider these suggestions in writing the agency guidelines required by the Regulatory Accounting Amendment of 1998 for the measures of costs and benefits to be used in next year's report to Congress on the costs and benefits of Federal Regulations.

One commenter suggested that OMB provide a "scorecard" identifying rules whose monetized benefits exceed their costs and rank rules according to net benefits or cost-effectiveness (8). One commenter suggested that OMB report on the cost-effectiveness of rules by agency, as it did in past years in the *Regulatory Program* (26). Regarding the benefits and costs of individual major rules, one commenter noted that the inclusion of agency estimates in the report should not imply that OMB agrees with them (1). These suggestions will also be considered for next year's report.

8. OMB's Use of It's Own Best Judgement/Best Estimates

Regarding aggregate estimates, three commenters said OMB should report its own and/or agency best estimates of benefits and costs as well as ranges (1,26,34). One of these commenters also suggested that OMB indicate the degree of confidence its analysts have in the estimates (1). We agree with the first statement and have attempted to do the best we can with the data available. The second suggestion is problematic since it would be subjective and vary by analyst.

Two commenters recommended that OMB provide its own estimates, and/or incorporate third-party estimates, of benefits and costs of individual rules, particularly where the agencies themselves fail to do so (8,12). Two other commenters also recommended that OMB provide its own estimates, even where the agency has done so (26,34). In this year's report, we have provided our own benefit estimates for economically significant rules in cases where the agencies failed to provide monetized benefit estimates but did provide quantitative data on benefits that we could monetize. These calculations and estimates are explained in Chapter III.

Several commenters recommended that OMB provide comment on the quality of agency analysis of rules (1,26,34,35). Many suggested that OMB evaluate and report on agency compliance with its Best Practices guidance (1,8,12,26,34). One commenter suggested that, at a minimum, OMB provide information on the assumptions underlying agency estimates (26). One commenter recommended a statutory requirement that agencies follow the Best Practices guidance. This commenter also recommended a statutory requirement for pre-publication peer review of agency regulatory analyses (22). One commenter suggested that OMB develop its own

estimates by applying consistent assumptions and methodologies to the agency estimates, consistent with Best Practices (26). One commenter recommended that OMB exercise its professional judgement and independent data rather than merely pass along agency estimates (22). These suggestions are consistent with the Regulatory Accounting Amendment's requirements for standardized measures and independent and external peer review of costs and benefits and the format of accounting statements and we will carefully consider them for the next report. However, they are beyond our capabilities for the current report. During the Congressional consideration of Senator Stevens' amendment, Members indicated their understanding that OMB's report would be based on a compilation of existing information. As Senator Glenn explained, "OMB will not have to engage in extensive analyses of its own, but rather is expected to use existing information. The sponsors of this amendment are aware of OMB's resource constraints and intend that the report be based on a compilation of existing information rather than new analysis." Cong. Rec. Senate 10398 (Sept. 12, 1996).

9. Other Comments

Several commenters urged us to provide more information on a disaggregated basis. Some comments suggested that the report should provide benefit and cost estimates by program, or even by program element where feasible (1, 26, 34). Other commenters urged that the report provide benefit and cost estimates for each major rule (1, 5, 8, 26, 34). This report added information on individual major rules to provide coverage of all major rules over the period from 1995 to March 31, 1998. We are committed to adding such information for additional years in the next report, as required by the Regulatory Accounting Amendment. As we develop this information for individual major rules, it will then be possible to examine the merits of assembling estimates for individual programs or program elements. Many of the same concerns that we identified with respect to the aggregate benefit and cost estimates may also apply in trying to develop such estimates for individual programs or program elements. In particular, we believe it would be far better to base any review of programs on new studies that evaluate after the fact (or ex post) the effectiveness and costs of individual programs rather than trying to construct benefit and cost estimates from ex ante regulatory analyses prepared five to ten years ago. Several of the commenters supported this view by noting the need for ex post studies performed by agencies or, better yet, disinterested parties (1, 12, 26).

Three commenters recommended that OMB establish a standardized format for agencies to present economic information on their rules (5, 8, 9, 34). One commenter suggested that an interagency working group develop an automated spreadsheet for all agencies to use for "first calculations" (10). One commenter recommended a statutory requirement that each regulatory agency produce an annual report on the benefits and costs of its own regulatory activities (8). Another commenter suggested a scheme whereby three agencies (OMB representing the executive branch, GAO representing the legislative branch, and the Federal Reserve Board representing the independent agencies) each produce a separate report on the benefits and costs of regulation. This commenter argued that this approach would minimize the influence any

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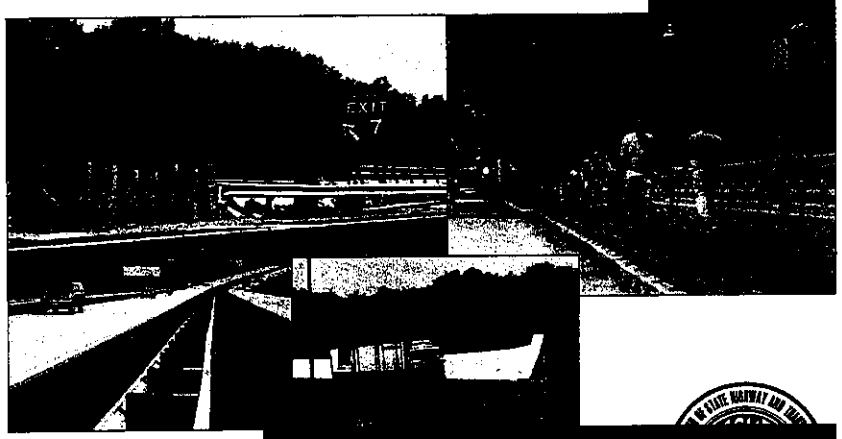

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PREFACE

This *Roadside Design Guide* was developed by the AASHTO Subcommittee on Design, Task Force for Roadside Safety under the chairmanship of David L. Little, P.E. This document presents a synthesis of current information and operating practices related to roadside safety and is written in dual units—metric and U.S. Customary units. This publication supersedes the 1996 AASHTO publication of the same name.

The roadside is defined as that area beyond the traveled way (driving lanes) and the shoulder (if any) of the roadway itself. Consequently, roadside delineation, shoulder surface treatments, and similar on-roadway safety features are not extensively discussed. While it is a readily accepted fact that safety can best be served by keeping motorists on the road, the focus of this guide is on safety treatments that minimize the likelihood of serious injuries when a driver does run off the road.

A second noteworthy point is that this document is a guide. It is not a standard, nor is it a design policy. It is intended for use as a resource document from which individual highway agencies can develop standards and policies. While much of the material in the guide can be considered universal in its application, there are several recommendations that are subjective in nature and may need modification to fit local conditions. However, it is important that significant deviations from the guide be based on operational experience and objective analysis.

To be consistent with AASHTO's *A Policy on Geometric Design of Highways and Streets,* design speed has been selected as the basic speed parameter to be used in this guide. However, since the design speed is often selected based on the most restrictive physical features found on a specific project, there may be a significant percentage of a project length where that speed will be exceeded by a reasonable and prudent driver. There will be other instances where roadway conditions will prevent most motorists from driving as fast as the design speed. Because roadside safety design is intended to minimize the consequences of a motorist leaving the roadway inadvertently, the designer should consider the speed at which encroachments are most likely to occur when selecting an appropriate roadside design standard or feature.

This 2001 edition of the AASHTO *Roadside Design Guide* has been updated to include hardware that has met the evaluation criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features." For the most part, roadside hardware tested and accepted under guidelines that are no longer applicable has not been included in this edition. Another significant change from the earlier editions of the Guide is the replacement of the benefit-cost analysis program ROADSIDE with the more user-friendly program called the Roadside Safety Analysis Program (RSAP). Detailed information on RSAP is included in Appendix A, but the program itself, including a detailed users guide, will be distributed separately.

Design values are presented in this document in both metric and U.S. Customary units. The relationship between the metric and U.S. Customary values is neither an exact (soft) conversion nor a completely rationalized (hard) conversion. The metric values are those that would have been used had the guide been presented exclusively in metric units; the U.S. Customary values are those that would have been used if the guide had been presented exclusively in U.S. Customary units. Therefore, the user is advised to work entirely in one system and not to attempt to convert directly between the two.

The reader is cautioned that roadside safety policy, criteria, and technology is a rapidly changing field of study. Changes in the roadside safety field are certain to occur after this document is published. Efforts should be made to incorporate the appropriate current design elements into the project development. Comments from users of this guide on suggested changes or modifications resulting from further developmental work or hands-on experience will be appreciated. All such comments should be addressed to the American Association of State Highway and Transportation Officials, Engineering Program, 444 North Capitol Street NW, Suite 249, Washington, DC 20001.

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This simplistic calibration method removed some of the inconsistencies in the earlier ROADSIDE SI tables. More importantly, it relates SI values to specific impact speeds for each roadside object or feature instead of average SI values. There are, however, two exceptions to this procedure. First, large vertical drops would not necessarily have an SI value of zero for an impact speed of zero because gravity would also play a large role in the probability of vehicle damage and occupant injury. Therefore, the regression lines for vertical drops were not fitted through the zero point. Second, lateral speed, V_{lat}, was used instead of impact speed for the SI relationships of longitudinal barriers since the severity of a longitudinal barrier impact is a function of both the impact speed and the impact angle. ($V_{lat} = V*\sin\theta$, where V is the impact speed and θ is the impact angle.)

A2.4 BENEFIT/COST MODULE

After the severity of a crash is estimated by the crash severity prediction module, the crash or societal costs associated with the crash are then calculated by multiplying the probability of each level of injury by the cost associated with that level of injury.

$$AC = \sum_{i=1}^{n} P(I_i) * C(I_i)$$

where:

AC = crash cost
$P(I_i)$ = probability of injury severity level "i"
$C(I_i)$ = cost associated with injury severity level "i"
n = total number of injury severity levels

As previously shown in Table A.1, the severity index (SI) is associated with six injury levels: fatality (K), severe injury (A), moderate injury (B), slight injury (C), property-damage-only level 2 (PDO2), and property-damage-only level 1 (PDO1). The severity estimate of the crash is then converted to crash costs using crash cost figures selected by the user. The program offers the choice of crash cost figures from the AASHTO *Roadside Design Guide* (2) or the FHWA comprehensive cost figures based on the willingness to pay approach, as shown in Table A.2. Alternatively, the user can input values for crash costs for various injury severity levels to suit the particular needs of the agency.

The crash costs are normalized to an annual basis. The normalization process involves two steps:

1. The crash cost is divided by the weighted number of encroachments and then multiplied by the expected number of encroachments per year to convert to an annual basis.

2. The crash cost is unweighted to arrive at the true crash cost. As discussed previously, the probability distributions for various encroachment characteristics are weighted to ensure proper sampling of conditions with very low probabilities to improve the accuracy of the analysis results and the speed at which the RSAP program arrives at a solution.

The direct costs, which include the costs for initial installation of the safety feature, normal maintenance, and repair of damages from crashes, are also normalized to an annual basis. The initial installation is converted to an annual basis using the project life and the discount rate. The normal maintenance cost is already entered on an annual basis. The cost of repairing roadside safety hardware is estimated by correlating repair costs to impact energy terms. For example, results from full-scale crash testing and computer simulations are used to determine the relationship between impact energy terms and length of guardrail damage. The unit repair cost for a typical guardrail, e.g., $50.00 per meter [$15.24 per foot] is then estimated. The total repair cost is therefore the product of the length of damaged rail and the unit cost for repair. Procedures for estimating the extent of hardware damage are developed for each longitudinal barrier design, as well as most common crash cushions, barrier terminals, and other roadside safety devices.

Incremental benefit/cost ratios are then calculated for all alternatives in a pairwise manner. As shown previously, the expression for calculating the incremental benefit/cost ratios is as follows:

$$B/C\ Ratio_{2-1} = (AC_1 - AC_2)/(DC_2 - DC_1)$$

where:

$B/C\ Ratio_{2-1}$ = incremental benefit/cost ratio of Alternative 2 compared to Alternative 1
AC_1, AC_2 = annualized crash or societal cost of Alternatives 1 and 2
DC_1, DC_2 = annualized direct cost of Alternatives 1 and 2

The numerator of this equation is the difference in crash or societal costs between the two alternatives. Since Alternative 2 is being evaluated as a potential safety

TABLE A.2 Crash cost figures*

Crash Severity	*Roadside Design Guide*	FHWA Comprehensive Cost
Fatal Crash	$1,000,000	$2,600,000
Severe Injury Crash	200,000	180,000
Moderate Injury Crash	12,500	36,000
Slight Injury Crash	3,750	19,000
PDO Crash Level 2	3,125	2,000
PDO Crash Level 1	625	2,000

* Crash cost figures are based upon the 1996 edition of the *Roadside Design Guide* and a 1994 FHWA memorandum entitled "Update of Value of Life and Injuries for Use in Preparing Economic Evaluations."

improvement over Alternative 1, the societal or crash costs of Alternative 1 would be expected to be higher than those of Alternative 2. Thus, the numerator is expressed as $(AC_1 - AC_2)$. The denominator of the equation represents the differences in direct costs to the transportation agency associated with implementing the safety improvement of Alternative 2 in relation to Alternative 1. Again, since Alternative 2 is being evaluated as a potential safety improvement over Alternative 1, the direct costs of Alternative 2 would be expected to be higher than those of Alternative 1. Hence, the denominator is expressed as $(DC_2 - DC_1)$.

A3.0 COMPARISON WITH ROADSIDE PROGRAM

Table A.3 presents the major differences between the RSAP program and the ROADSIDE program, which is the cost-effectiveness analysis procedure presented in previous versions of the *Roadside Design Guide*(2,3). ROADSIDE uses a constant encroachment rate of 0.0003 encroachment per km [0.0005 encroachment per mile] per year per ADT. The lateral extent of encroachment distribution is based on a constant deceleration rate of 3.66 m/sec/sec [12 ft/sec/sec], or 0.4 g, and a sine curve density function for steer back. In comparison, the RSAP program uses the Cooper encroachment data. Adjustments were made to account for encroachments with 4 m [13.1 ft] or less of lateral extent which might not have been detected due to presence of paved shoulders.

ROADSIDE uses a hypothetical distribution for encroachment speed based on design speed and an average encroachment angle based on the point-mass model. A constant deceleration rate of 3.66 m/sec/sec [12 ft/sec/sec], or 0.4 g, is assumed for calculating the impact speed from the encroachment speed. A straight path is assumed so that the impact angle is the same as the encroachment angle. In comparison, RSAP uses impact speed and angle distributions from real-world crash data. A straight path with no braking is assumed so that the encroachment speed and angle are the same as the impact speed and angle.

ROADSIDE uses only a single vehicle type and an average encroachment angle for the hazard imaging. Vehicle orientation is not taken into account. The program can handle only one hazard at a time and shielding of one hazard by another is not incorporated. For multiple hazards, each hazard has to be analyzed individually and the crash costs summed manually. In comparison, RSAP allows for 12 vehicle types. Vehicle orientation is incorporated into the program based on real-world crash data. Hazard imaging is based on the size of the vehicle, encroachment angle, and vehicle orientation. The program can handle multiple hazards with algorithms to account for shielding of one hazard by another and multiple impacts.

ROADSIDE uses an average severity index without accounting for speed. RSAP estimates severity as a function of impact speed instead of an average value. These improvements incorporated into RSAP provide better severity estimates, which is perhaps the most critical element for estimating crash costs. Further, ROADSIDE assumes that all impacts with a hazard shielded by a barrier are eliminated, regardless of barrier length. RSAP allows for impact with a hazard shielded by barrier if the vehicle encroaches upstream of the barrier.

A4.0 SUMMARY

This appendix provides a summary of the conceptual framework and algorithms contained in the RSAP computer program, which has been created to assist in the economic analysis of existing or proposed roadside conditions. For users desiring more detailed information, please refer to the *Engineer's Manual*. Also, for detailed descriptions on the operation of the RSAP program, please refer to the *User's Manual*.

U.S. Department of Transportation
Office of the Secretary of Transportation

Memorandum

Subject: Revised Departmental Guidance
Treatment of Value of Life and Injuries in Preparing Economic Evaluations

Date: January 29, 2002

From: Kirk K. Van Tine, General Counsel
Linda Lawson, Acting Deputy Assistant Secretary for Transportation Policy

Reply to Attn. of: PBelenky x65421

To: Assistant Secretaries
Modal Administrators

On January 8, 1993, to promote consistency among the policies of the several operating administrations, DOT published a guidance memorandum, "Treatment of Value of Life and Injuries in Preparing Economic Evaluations." That memorandum recommended the use of $2.5 million as the benefit of averting an accidental fatality in departmental regulatory and investment analyses. This figure has been periodically adjusted for inflation by the GDP implicit price deflator. The current value of $2.7 million was adopted in 1996.[1]

Recent years have seen a considerable expansion in the number of studies published and refinement in analytical techniques. However, it does not appear that newer estimates converge on a consensus value or range that would justify modification of our established standard, and some significant estimates continue to lie well below it. Therefore, for the present, we will continue to use the procedure adopted in the 1993 guidance. Adjusting the value of life by the GDP implicit deflator for the third quarter of 2001, we now recommend the use of a value of $3.0 million in all DOT analyses. We will continue to review available research and may recommend changes to the value of life if warranted. The relative values of injuries of varying severity are unchanged from those published in the 1993 memorandum.

It is important to emphasize that these values are imprecise and should be treated neither as an automatic justification for action nor as a rigid barrier, but as a guide to thoughtful decision-making. Where the estimated benefits of an action are close to the estimated costs, governmental decision-makers should pay particular attention to the accuracy of all other factors in the cost-benefit analysis.

To deepen understanding of the empirical basis for these values among analysts who use them and to facilitate evaluation of current studies, we are initiating a process of consultation within the department. Before proposing major revisions, we intend to invite experts in this field of research to meet informally with DOT staff and share insights into the state of the art and the issues that must be considered in developing policy. We will announce meetings as they are scheduled.

[1] The original guidance memorandum and background information on relevant sources may be found at http://ostpxweb.dot.gov/VSL_background.htm

U.S. Department of Transportation

Federal Aviation Administration

APO Bulletin

Office of Aviation Policy and Plans

February 2002 APO-02-1

Treatment of Value of Life and Injury In Economic Analyses

To reflect inflation, the Office of the Secretary of Transportation (OST) has increased the recommended valuation for the benefit of averting an accidental fatality in economic analyses conducted within the Department of Transportation to $3.0 million.[1]

Basic procedures for establishing this value and recommended values for the benefit of an averted injury are unchanged from previous OST guidance specifying that these values be based on the "willingness to pay" (WTP) by society for reduced risks of fatalities and injuries.[2] The OST guidance also recommends a method for valuing averted injuries based on the current value of an averted fatality and the Abbreviated Injury Scale (AIS)—a comprehensive system for rating the severity of accident-related injuries recognizing six levels of injury severity. Each AIS severity level injury is related to the loss of quality and quantity of life resulting from an injury typical of that level and is expressed as a fraction of a fatality. WTP to avoid an injury of a particular AIS level is estimated by multiplying the fractional fatality value associated with the AIS level by the value of avoiding a fatality. AIS levels, their associated fractional fatality values, and the corresponding WTP value of each injury level are provided in Table 1.

Table 1
WTP Values Per AIS Injury Level

AIS Code	Description of Injury	Fraction of WTP Value of Life	WTP Value (2001 dollars)
AIS 1	Minor	0.20 Percent	$6,000
AIS 2	Moderate	1.55 Percent	$46,500
AIS 3	Serious	5.75 Percent	$172,500
AIS 4	Severe	18.75 Percent	$562,500
AIS 5	Critical	76.25 Percent	$2,287,500
AIS 6	Fatal	100.00 Percent	$3,000,000

[1] "Revised Departmental Guidance, Treatment of Value of Life and Injuries in Preparing Economic Evaluations," Office of the Secretary of Transportation Memorandum, January 29, 2002.
[2] "Treatment of Value of Life and Injuries in Preparing Economic Evaluations," Office of the Secretary of Transportation Memorandum, January 8, 1993.

Where specific information is available on separate injuries by AIS level, APO recommends that the WTP to avoid each specific injury be separately valued according to Table 1. Often, more than one injury will be associated with a person injured in an aviation accident. If valuation is to be presented on a per victim basis, WTP values for each injury suffered by the same person should be aggregated.

Costs other than WTP values are generally associated with transportation fatalities and injuries. These include the costs of emergency services, medical care, and legal and court services (the cost of carrying out court proceedings—not the cost of settlements). These other avoided costs should be considered as separate benefits, additional to the WTP value.

Because medical and legal costs of separate injuries to the same victim are not necessarily additive, APO advises that medical and legal costs be valued on a per victim basis. Table 2 provides direct per victim medical and legal costs classified according to the worst AIS injury sustained by each aviation accident victim. Thus, the values in Table 2 should be added only once to the aggregated sum of the WTP values for injuries suffered by any particular individual.[3]

Table 2
Per Victim Medical and Legal Costs Associated with Injuries
(2001 dollars)

AIS Code	Maximum AIS Injury	Emergency/ Medical	Legal/Court	Direct Total
AIS 1	Minor	$600	$1,900	$2,500
AIS 2	Moderate	$4,000	$3,100	$7,100
AIS 3	Serious	$16,500	$4,700	$21,200
AIS 4	Severe	$72,500	$39,100	$111,600
AIS 5	Critical	$219,900	$80,100	$300,000
AIS 6	Fatal	$52,600	$80,100	$132,700

Source: *Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs*, FAA-APO-89-10, October 1989, Section 3 , as adjusted for price level changes.

Although the methodology specified above should be used when possible, aviation injury data are often incomplete and/or unavailable at the AIS level. Most frequently, aviation injuries are reported by the number of victims suffering "serious" and "minor" injuries as defined by the International Civil Aviation Organization (ICAO). Under this classification, serious injury victims are typically (but not always) those with at least one injury at AIS 2 or higher, whereas minor injury victims typically (but not always) have injuries at the AIS 1 level only.

[3] Similar direct costs apply in the case of fatalities. However, APO estimates that these direct costs are less than $50,000 per fatality—not enough to shift the $3.0 million WTP value after allowances for the rounding convention—to the nearest $100,000—used by OST.

To calculate economic values for the ICAO serious and minor injury categories, APO analyzed aviation injury data maintained by the National Transportation Safety Board (NTSB) that contain both ICAO and complete AIS injury codes. AIS values for all injuries sustained by accident victims in each ICAO category were summed and then divided by the number of victims in each category to determine per victim WTP values.[4] These WTP values are reported in Table 3. Medical and legal direct costs reported in Table 3 reflect weighted averages of the values listed in Table 2.

Table 3
Average Per Victim Injury Values for Serious and Minor Injuries
(2001 dollars)

ICAO Code	WTP Values	Emergency/ Medical	Legal/ Court	Total Value
MINOR (ICAO 2)	$37,900	$2,300	$2,700	$42,900
SERIOUS (ICAO 3)	$536,000	$31,300	$13,400	$580,700

John M. Rodgers
Director of Aviation Policy and Plans

[4] Eric Gabler, "Update of FAA Values of Avoided Injury," Draft Working Paper, Office of Aviation Policy and Plans, February 1994.

Text of H.R. 2926

An Act

(*) See Page 14

To preserve the continued viability of the United States air transportation system.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Air Transportation Safety and System Stabilization Act'.

TITLE I--AIRLINE STABILIZATION

SEC. 101. AVIATION DISASTER RELIEF.

(a) IN GENERAL- Notwithstanding any other provision of law, the President shall take the following actions to compensate air carriers for losses incurred by the air carriers as a result of the terrorist attacks on the United States that occurred on September 11, 2001:

(1) Subject to such terms and conditions as the President deems necessary, issue Federal credit instruments to air carriers that do not, in the aggregate, exceed $10,000,000,000 and provide the subsidy amounts necessary for such instruments in accordance with the provisions of the Federal Credit Reform Act of 1990 (2 U.S.C. 661 et seq.).

(2) Compensate air carriers in an aggregate amount equal to $5,000,000,000 for--

(A) direct losses incurred beginning on September 11, 2001, by air carriers as a result of any Federal ground stop order issued by the Secretary of Transportation or any subsequent order which continues or renews such a stoppage; and

(B) the incremental losses incurred beginning September 11, 2001, and ending December 31, 2001, by air carriers as a direct result of such attacks.

(b) EMERGENCY DESIGNATION- Congress designates the amount of new budget authority and outlays in all fiscal years resulting from this title as an emergency requirement pursuant to section 252(e) of the Balanced Budget and Emergency Deficit Control Act of 1985 (2 U.S.C. 901(e)). Such amount shall be available only to the extent that a request, that includes designation of such amount as an emergency requirement as defined in such Act, is transmitted by the President to Congress.

SEC. 102. AIR TRANSPORTATION STABILIZATION BOARD.

SEC. 401. SHORT TITLE.

This title may be cited as the `September 11th Victim Compensation Fund of 2001'.

SEC. 402. DEFINITIONS.

In this title, the following definitions apply:

(1) AIR CARRIER- The term `air carrier' means a citizen of the United States undertaking by any means, directly or indirectly, to provide air transportation and includes employees and agents of such citizen.

(2) AIR TRANSPORTATION- The term `air transportation' means foreign air transportation, interstate air transportation, or the transportation of mail by aircraft.

(3) CLAIMANT- The term `claimant' means an individual filing a claim for compensation under section 405(a)(1).

(4) COLLATERAL SOURCE- The term `collateral source' means all collateral sources, including life insurance, pension funds, death benefit programs, and payments by Federal, State, or local governments related to the terrorist-related aircraft crashes of September 11, 2001.

(5) ECONOMIC LOSS- The term `economic loss' means any pecuniary loss resulting from harm (including the loss of earnings or other benefits related to employment, medical expense loss, replacement services loss, loss due to death, burial costs, and loss of business or employment opportunities) to the extent recovery for such loss is allowed under applicable State law.

(6) ELIGIBLE INDIVIDUAL- The term `eligible individual' means an individual determined to be eligible for compensation under section 405(c).

(7) NONECONOMIC LOSSES- The term `noneconomic losses' means losses for physical and emotional pain, suffering, inconvenience, physical impairment, mental anguish, disfigurement, loss of enjoyment of life, loss of society and companionship, loss of consortium (other than loss of domestic service), hedonic damages, injury to reputation, and all other nonpecuniary losses of any kind or nature.

(8) SPECIAL MASTER- The term `Special Master' means the Special Master appointed under section 404(a).

SEC. 403. PURPOSE.

It is the purpose of this title to provide compensation to any individual (or relatives of a deceased individual) who was physically injured or killed as a result of the terrorist-related aircraft crashes of September 11, 2001.

SEC. 404. ADMINISTRATION.

(a) IN GENERAL- The Attorney General, acting through a Special Master appointed by the Attorney General, shall--

(1) administer the compensation program established under this title;

(2) promulgate all procedural and substantive rules for the administration of this title; and

(3) employ and supervise hearing officers and other administrative personnel to perform the duties of the Special Master under this title.

(b) AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to pay the administrative and support costs for the Special Master in carrying out this title.

Federal Register

Monday
October 4, 1993

Part VIII

The President

Executive Order 12866—Regulatory Planning and Review

Federal Register
Vol. 58, No. 190
Monday, October 4, 1993

Title 3—

The President

Executive Order 12866 of September 30, 1993

Regulatory Planning and Review

The American people deserve a regulatory system that works for them, not against them: a regulatory system that protects and improves their health, safety, environment, and well-being and improves the performance of the economy without imposing unacceptable or unreasonable costs on society; regulatory policies that recognize that the private sector and private markets are the best engine for economic growth; regulatory approaches that respect the role of State, local, and tribal governments; and regulations that are effective, consistent, sensible, and understandable. We do not have such a regulatory system today.

With this Executive order, the Federal Government begins a program to reform and make more efficient the regulatory process. The objectives of this Executive order are to enhance planning and coordination with respect to both new and existing regulations; to reaffirm the primacy of Federal agencies in the regulatory decision-making process; to restore the integrity and legitimacy of regulatory review and oversight; and to make the process more accessible and open to the public. In pursuing these objectives, the regulatory process shall be conducted so as to meet applicable statutory requirements and with due regard to the discretion that has been entrusted to the Federal agencies.

Accordingly, by the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Section 1. *Statement of Regulatory Philosophy and Principles.* (a) *The Regulatory Philosophy.* Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

(b) *The Principles of Regulation.* To ensure that the agencies' regulatory programs are consistent with the philosophy set forth above, agencies should adhere to the following principles, to the extent permitted by law and where applicable:

(1) Each agency shall identify the problem that it intends to address (including, where applicable, the failures of private markets or public institutions that warrant new agency action) as well as assess the significance of that problem.

(2) Each agency shall examine whether existing regulations (or other law) have created, or contributed to, the problem that a new regulation

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET

REGULATORY PROGRAM OF THE UNITED STATES GOVERNMENT

April 1, 1988 - March 31, 1989

(*) Annotated.

REGULATORY POLICY GUIDELINES

In addition to creating a process to improve Executive coordination of agency regulatory decisions, Executive Order No. 12291 sets out President Reagan's governing goals for the agency regulatory programs. These Presidential regulatory principles are complemented by regulatory review requirements which, to the extent permitted by law, require agencies to assess the benefits and costs of their regulations and to attempt to achieve the greatest net social benefits in making their decisions. As experience with Executive Order No. 12291 accumulated, the Administration refined these policies and developed a set of ten Regulatory Policy Guidelines to assist agency regulatory analysis in the rulemaking process.[23]

The ten guidelines attempt to address the most frequently encountered issues in Federal regulation and guide the agencies in the administration of regulatory programs. Of necessity their application is subject to the caveat that this type of analysis is not precluded by law. The guidelines make clear that a significant obstacle to making many regulations more rational is the language of the statutes themselves. For example, statutes sometimes require uniform national engineering standards when far superior policies for attaining the goal sought are available, or they require severe restrictions or prohibitions of certain products without considering the total public health consequences.

For analytical purposes, the ten Regulatory Policy Guidelines can be divided into two categories: those that address economic and analytic justification for regulatory proposals, and those that suggest the particular types of strategies or regulation that are most likely to produce fair and responsive government.

POLICY GUIDELINES REQUIRING ECONOMIC AND ANALYTIC JUSTIFICATION

> Regulatory Policy Guideline No. 1:[24] Regulations should be issued only on evidence that their potential benefits exceed their potential costs. Regulatory objectives, and the methods for achieving these objectives, should be chosen to maximize the net benefits to society.

The first guideline restates the basic principles of Executive Order No. 12291. It applies to all kinds of regulation: economic (the regulation of markets and economic relationships); social (health, safety, and environmental regulation); and administrative (the management of Federal funds and resources).[25] (*)

As with Executive Order No. 12291, this guideline is to be used only "to the extent permitted by law." Executive branch policies cannot override explicit statutory directions. Some regulatory statutes direct certain actions regardless of costs, benefits, or both. On the other hand, where there is policy discretion the President has a Constitutional responsibility to provide guidance to the departments and agencies in exercising the discretion they do have.

The point at which a given regulation's benefits exceed its costs can be a matter of uncertainty and controversy.[26] A Regulatory Impact Analysis (RIA) is required by Executive Order No. 12291 for "major" regulations and is to contain a benefit-cost analysis for such proposed regulatory actions.[27] (*) In recent years there have been a number of agency RIAs that contained carefully prepared analyses in support of major regulatory initiatives and demonstrated net benefits that were clearly positive, for example, the RIAs analyzing the Department of Transportation's (DOT's) center high-mounted stop-lamps, the Environmental Protection Agency's (EPA's) lead phasedown, and the Occupational Safety and Health Administration (OSHA's) fall protection regulations.[28]

DOT issued its regulation requiring automobiles to have a center high-mounted stop-lamp in 1983. DOT first conducted extensive analyses estimating the potential benefits and costs. To do so, DOT conducted several experiments in which fleets of automobiles were equipped with various types of stop-lamps in order to measure their relative effectiveness in reducing rear-end collisions. This regulation is one of the most highly visible success stories of the Administration's regulatory reform program. These stop-lamps are seen almost every time one follows an automobile manufactured since 1986.

EPA's lead in gasoline phasedown rule was also accompanied by extensive and high-quality economic analysis that clearly established that the benefits of

[23] These Regulatory Policy Guidelines were set forth in the August 11, 1983, Report of the Presidential Task Force on Regulatory Relief.

[24] These Regulatory Policy Guidelines do not appear in numerical order in this text. They are given the same numerical designations as they were given in the August 11, 1983, Report of the Presidential Task Force on Regulatory Relief.

[25] For a discussion of this taxonomy and list of the regulatory programs each category entails, see the 1985 *Regulatory Program of the United States Government*, pp. xiv–xxiii.

[26] Appendix V provides guidelines on how to estimate benefits and costs and how to organize these data and facts to aid the policymakers in their regulatory decisions.

[27] Generally, a major rule is a regulation that is likely to result in (1) an annual effect on the economy of $100 million or more, (2) a major increase in costs or prices, or (3) significant adverse effects on competition, employment, investment, productivity, or innovation. (*)

[28] The 1987 Regulatory Program also discussed nine regulatory impact analyses performed by five agencies. See "The Role of Regulatory Impact Analysis" in the 1987 *Regulatory Program of the United States Government* (pp. xv to xxii).

transportation services comes from the Department of Transportation and the Department of Health and Human Services (HHS), these two Federal agencies should closely work with State and local recipients of these funds to eliminate these barriers. The Joint DOT/HHS Council on Transportation Coordination met in June 1988 to review draft responses to many of the barriers identified by the States. The Council has developed a set of recommendations and clarfying information that will help State and local governments overcome these barriers. This information will be provided to States and localities in the near future.

Still other proposals concern agency policies and regulatory interpretations. The State of Nevada was concerned that residents living in trailer parks are not considered in determining eligibility for loans under the Department of Agriculture's (USDA's) Farmers Home Administration (FmHA) loan program, because trailer parks are considered to be commercial properties. USDA has responded that under existing regulations, all rural residents should be considered in determining loan eligibility, regardless of whether they live in a trailer park. FmHA has reviewed this interpretation with its Utah State Office, which serves Nevada.

The State of New Jersey proposed greater flexibility in compliance with regulations requiring States to maintain and use an income and eligibility verification system (IEVS) to verify program eligibility in the AFDC and Food Stamp programs. These regulations require States to request and verify wage information from a State source on a quarterly basis and from the Social Security Administration on an annual basis. These data bases, according to New Jersey, overlap to a large extent. The State proposes that States have the option, rather than be required, to request wage, self-employment, and pension information from SSA. Recent regulations issued by the Department of Agriculture and rules soon to be issued by the Department of Health and Human Services permit States to exclude SSA wage data if followed up previously from the State source.

These are only a few of the National Governors' Association's regulatory relief proposals that the Administration has decided to implement. A complete report will be issued to the NGA in early August.

SUMMARY

Federalism is a long-standing, enduring philosophy dating back to the beginning of our Republic. Our system of government was founded on the notion that the power to govern this Nation belongs to the states unless designated to the central government—yet one more check on an overly powerful national government. But Federalism has become much more than a defense against tyranny. As this chapter has attempted to illustrate, Federalism is now considered a commonsense, effective way to govern. By using the special abilities and expertise of the States, the Nation can better assure that services are provided fairly and efficiently to its citizens.

While this Administration did not invent the Federalism concept, President Reagan has instilled it with a new and vigorous spirit. By promoting Federalism principles in Executive branch rulemaking, establishing a meaningful dialogue between the national government and the States, and promulgating an Executive order intended to steer Federal policymaking away from unwarranted intrusion into State and local affairs, this Administration has significantly enhanced the role of Federalism in American government. The challenge to future administrations is to build upon this foundation.

THE ROLE OF ECONOMIC ANALYSIS IN THE DEVELOPMENT OF RESPONSIBLE REGULATION

Government regulation permeates everyday life, affecting among other things the labels on our foods, the design of our cars, the fabric of our clothes, and the air we breathe. Federal regulation continues to be one of the major ways that our government achieves basic societal goals, rivaled in influence on our daily lives only by tax and expenditure polices.

Regulations can make important contributions to the Nation's welfare. For example, the National Highway Traffic Safety Administration estimates that its Center High-Mounted Stop-Lamp regulation will annually prevent 40,000 injuries and over $400 million in property damage by reducing the number and severity of rear-end collisions. But these benefits are not free; the regulation is estimated to cost $70 million per year ($7 for each car). The resources used to meet these regulatory requirements are not available to meet other important requirements for the Nation's welfare, such as making cars with lower exhaust emissions. Consequently Federal regulatory actions will improve the Nation's welfare only if the societal benefits of the actions exceed the societal costs; i.e., if the net benefits are positive.

Over the last two decades, we have learned valuable lessons about the development and use of regulations. First, because our society is complex, regulating it is no easy task. Reaching an acceptable administrative resolution of complex regulatory issues requires extensive data collection, thorough analysis, and difficult legal, economic, and political decisions. Developing and enforcing a major regulation can absorb a large share of a regulatory agency's resources. And in the case of controversial rules there can be a protracted period of litigation, court review, and often remand to the agency for further work.

Second, Federal regulatory initiatives have often failed to achieve their objectives and, in some instances, have had unintended effects that have undermined the regulatory program. Effective regulation must anticipate the ingenuity of the regulated community and the ingrained reluctance of people to change behavior.

Finally, Federal regulation imposes substantial costs on the American economy by redirecting resources from other uses, both private and public, to meet regulatory requirements. Current estimates suggest that Federal regulatory costs may be as high as $150 billion per year; the Environmental Protection Agency (EPA) alone may be responsible for regulatory costs of $70 to $80 billion per year. And the cost of the Federal regulatory structure continues to increase as new regulations are added.

[36] The cost of major EPA and Department of Labor regulations issued in 1987, in billions of 1987 dollars, is as follows:

	Annual Cost	Present Value of Cost Over 30 Years
Environmental Protection Agency		
Pesticides and Toxic Substances		
Asbestos in Schools	$0.33	$3.14
Water		
Organic Effluent Limitation	0.53	4.90
Solid Waste and Emergency Response		
California List	0.09	0.89
Right to Know	0.32	2.99
Air and Radiation		
PM10	0.17	1.66
Industrial Boilers	0.47	0.44
Department of Labor		
Occupational Safety and Health		
Hazard Communication	0.19	1.83
Grain Handling	0.04 to 0.07	0.39 to 0.65
Benzene	0.02	0.23
Formaldehyde	0.06	0.61
Total	2.22 to 2.25	17.08 to 17.34

Note: A more detailed explanation of how these cost estimates were derived is available upon request. The PM 10 estimate is incremental to the existing PM NSPS program.

Over the last year, for example, two major Federal agencies — the Department of Labor and EPA — have issued major rules imposing additional regulatory costs of $2.2 billion per year.[36]

Because of the importance of understanding the effects of major regulations, President Reagan issued Executive Order No. 12291. This Order requires Federal agencies to analyze "the need for and consequences of proposed government action in order to design regulatory measures that, to the extent permitted by law, maximize net benefits to society." Among other things, Executive Order No. 12291 requires Executive branch agencies to prepare a regulatory impact analysis (RIA) for each major rule. The basic objective of the RIA requirement is to ensure that regulatory policymakers have the best information available on the likely benefits and costs of regulatory alternatives so they can make better decisions and to provide the public, Congress, and the courts with a better understanding of the basis for agency decisionmaking.

There are two fundamental questions that must be answered if an RIA is to be useful in helping to guide a rulemaking decision: (1) is there a genuine need for Federal regulatory action and (2) if so, under what conditions can the benefits of the action be expected to exceed its costs? To answer the first question, the agency must determine whether Federal regulation can accomplish the objective more efficiently than the market or some alternative to Federal regulation. If the answer to the first question is "no", there is no need to answer the second question unless statutory requirements mandate Federal regulation. To answer the second question, the agency must identify several alternative regulatory actions and evaluate the benefits and costs of each action while accounting for the uncertainty of those benefits and costs.

ASCERTAINING THE NEED FOR FEDERAL REGULATORY ACTION

The Theory of Markets

According to economic theory, competitive markets generally perform well in supplying the economic goods and services people want. Thus there is a strong presumption that government intervention into markets should only be undertaken when markets are not working, that is, where there is a so-called "market failure." Market failures can be divided analytically into three categories: externality,[37] public good (including problems arising

[37] An externality occurs when one party's actions impose uncompensated costs or benefits on third parties not part of the market transaction. For instance, environmental problems, such as air emissions from a manufacturing plant, may impose soiling costs or health problems on neighbors.

benefits foregone as a consequence of choosing that alternative. For example, the opportunity cost of banning a product (e.g., a drug, food additive, or hazardous chemical) is the loss of benefits to consumers of not being able to buy that product.

All costs calculated should be incremental, that is, they should represent changes in costs that would occur if the regulatory alternative is chosen compared to costs incurred under a less stringent alternative. Future costs that would be incurred even if the regulation is not promulgated, as well as costs that have already been incurred (sunk costs), are not part of incremental (or marginal) costs.

The RIA should explain any expected incremental costs that cannot be monetized. An important type of cost that often cannot be monetized is a slowing in the rate of innovation or of adoption of new technology. For example, regulations requiring a costly and time-consuming approval process for new products or new facilities may have such costs, as may regulations setting much more stringent standards for new facilities than for existing ones.

Treatment of Risk and Uncertainty

Where benefit or cost estimates are heavily dependent on underlying assumptions, the RIA should make these assumptons explicit so that information on all elements of the analysis is fully apparent to users of the analysis (e.g., reviewing policymakers, Congress, and the public). Because the particular estimation approach adopted may involve a complicated model, it is important for the agency to make hidden assumptions explicit and present sensitivity analyses (i.e., show the effects of alternate assumptions on costs and benefits) based on plausible alternative assumptions.

Wherever benefit or cost estimates are uncertain, an agency should present "most likely" estimates (in statistical terms, unbiased estimates or expected values). Where possible, an agency should also present information about the likelihood that the true value is different from the estimate or at least present plausible lower and upper bound estimates. Often benefit/cost analyses rely on a number of different studies that yield a range of estimates. In these cases the midpoint of the range of extreme values provided by the studies does not represent the most likely estimate, because the most extreme estimates may be the least reliable. Such an approach ignores the results of the other studies. The correct approach would use all available information and derive a most likely estimate as a weighted average of the estimates of the individual studies, with the weight of each estimate based on the reliability of the study that produced it.

For many regulations the estimates of benefits are often less certain than the cost estimate. This is particularly the case where the benefits of regulation take the form of a reduction in health and safety risks. Costs can often be calculated by estimating the expenses of purchasing and installing new equipment or of adopting different work practices. On the other hand, benefits may be estimated on the basis of an hypothesized reduction in cancer cases, injuries, or crop damage.

Unfortunately this uncertainty on the health or benefit side is sometimes dealt with in a way that is inconsistent with the way it is generally dealt with on the cost side. Some agencies have adopted the practice of "erring on the side of safety" or adding "margins of safety" at each step in the risk assessment process. This means that the policy official usually does not know *how* conservative the benefit or risk reduction estimates are; just that they are conservative.

These practices, both informal and formal, are counterproductive to the provision of a safer and healthier society because it is impossible (given the bias in the risk estimates) to direct the limited resources available to produce the greatest reduction in risks. This danger is well recognized by policy analysts and scientists, especially those outside the regulatory agencies. For example, the National Academy of Science issued a report in 1983 recommending that:

> regulatory agencies take steps to establish and maintain a clear conceptual distinction between assessment of risks and consideration of risk management alternatives; that is, the scientific findings and policy judgments embodied in risk assessments should be explicitly distinguished from the political, economic, and technical considerations that influence the design and choice of regulatory strategies.[45]

If both the costs of regulations and the risk reductions they bring about are estimated using the expected value approach a realistic opportunity exists for obtaining the most risk reduction for society from a given level of expenditures.

DISCOUNTING

Discounting takes account of the fact that resources (goods or services) in a given year are worth more than identical resources in a later year, since resources can be invested today so as to return more resources later. Because of this productvity of investment, the timing of benefits and costs must be taken into account. For example, a dollar invested today at 10 percent per year will return $2.59 in ten years. Thus the opportunity cost of a dollar foregone today is $2.59 in ten years. By the same argument, a regulatory benefit occurring today and worth $1.00 is equivalent to a benefit of $2.59 ten years from now. The appropriate way to account for such differences in the timing of benefits and costs is by discounting.

If costs and benefits occur in different years, the RIA should evaluate the benefit and cost streams (in constant dollars) over a comparable timeframe. Generally the RIA would make the adjustment by discounting the benefit and cost streams to their present values, but there are alternative approaches that are equally valid, such as annualizing the benefit and cost streams over the appropriate timeframe.

[45] National Research Council, *Risk Assessment in the Federal Government: Managing the Process*. National Academy Press, Washington, DC 1983: p. 7.

CRITIQUE OF RIAS

Last year's Regulatory Program examined some of the key elements of the RIA (as discussed above) in the context of nine RIAs covering a broad spectrum of regulatory actions. As a part of that review, the conclusion was reached that most of the RIAs represented a substantial improvement—particularly in terms of developing benefit estimates—over the economic analyses prepared under the procedures established in earlier years.

At the same time, however, some important shortcomings were identified. Some of these RIAs, OSHA's Asbestos standard RIA, for example, evaluated only a single regulatory option—the selected option.

In addition the treatment of uncertainty in some cases largely failed to convey the full scope of the uncertainty in the analysis. Some agencies, for example, had used "worst case" or "upper bound" estimates instead of most likely estimates in calculating the likely benefits of a regulation. In OSHA's RIA for ethylene oxide (Eto), the health risks are based on "worst-case" estimates of exposure in terms of both the concentration level and the duration of exposure. As a result, the combined effect of these "worst-case" assumptions yields an estimate of exposure risk five to ten times greater than the most likely estimate.

Most of the RIAs used some form of discounting as a way of addressing the problem of adjusting benefit and cost streams so that they could be considered in a comparable time frame. However, in some cases, RIAs only discounted the cost streams, without discounting the benefits. This is the case, for example, in OSHA's RIA for Eto. This differential treatment—discounting costs, but not benefits—can also be a significant source of bias in a benefit/cost analysis. In the Eto RIA, the cost per cancer avoided is increased by a factor of five if neither costs nor benefits are discounted and by more than a factor of ten if a consistent approach is adopted in discounting both benefits and costs.

Finally, once the benefits and costs have been estimated and placed on an equal footing by discounting future benefits and costs to the present and using the same basic methodology to produce "expected value" or most likely estimates, benefits and costs must be presented in some systematic format helpful to decision makers.[46]

In practice, however, many RIAs fail to develop an estimate of net benefits, either because statutes prohibit regulatory decisions based on benefit-cost evaluation or because the data needed for such calculations are simply unavailable. In these cases, RIAs

Table I

RISK-COST TRADEOFFS FOR SELECTED REGULATIONS

Regulation	Agency	Year issued	Cost per statistical life saved ($ millions)
Unvented space heaters	CPSC	1980	$ 0.07
Servicing wheel rims	OSHA	1984	0.25
Fuel system integrity	NHTSA	1975	0.29
Fall protection	OSHA	1985	1.40
Uranium mill tailings (active)	EPA	1983	53.00
Ethylene oxide	OSHA	1984	60.00
Asbestos	OSHA	1986	89.00
DES ban in cattlefeed	FDA	1979	132.00

Sources: *Regulatory Program of the United States Government*, April 1, 1986—March 31, 1987, p. xxi; Morrall, J. F., "A Review of the Record," *Regulation*, November–December 1986.

Note: In 1984 dollars, discounted at 10 percent. Each nonfatal accident requiring hospitalization is treated as equivalent to one-fiftieth of a fatality. This relationship was selected as representative of the willingness-to-pay values for fatality risks relative to injury risks found by research studies. Cancer is counted as a fatality. Cancer latency periods were assumed to be 15 years for lung cancer associated with uranium mill tailings, 30 years for mesothelioma and lung cancer associated with asbestos exposure, and ten years for the leukemia and breast cancer associated with ethylene oxide and DES, respectively.

Discounting benefits and costs at 4 percent instead of 10 percent does not affect the conclusion that there are extremely wide variations in cost per statistical life saved between these regulations, nor does it affect the cost-effectiveness rankings. Discounted at 4 percent, banning DES in cattlefeed still costs 1,500 times more per statistical life than regulating unvented space heaters.

from inadequate information),[38] and natural monopoly.[39] In order to establish the need for a Federal regulatory initiative, then, the RIA should first determine whether the proposed regulatory action addresses a genuine problem.

In theory the need to establish a market failure is fundamental, because there will be no net benefits to society (in fact there must be a net social loss) resulting from a regulatory action unless there is a market failure. Of course not all market failures can be remedied effectively through government regulation. In these instances the market solution, though imperfect, may be better than the regulatory alternative. An analysis of the underlying problems with the operation of markets should help determine the need for rulemaking.

In those instances in which legislation requires regulatory action without such analysis, RIAs should focus on the least burdensome means of achieving the statute's goals.

Alternatives to Federal Regulation

If the agency identifies a need for governmental intervention, it must then decide whether Federal regulatory action is the best way to resolve the problem. There may be no need for Federal regulatory action if other approaches are more likely to resolve the problem. Such alternatives include: the judical system (for example, liability cases to discipline health and safety protection), antitrust enforcement, workers' compensation systems, and regulation at the State or local level.

In general, because demands among localities for different governmental services differ, and because competition among governmental units for taxpayers and citizens encourages efficient regulation, the agency should look to the lowest level of government (Federal, State, or local) capable of correcting the problem. In some cases the nature of the market failure itself may suggest the most appropriate governmental level of regulation. For example, pollution that spills across State lines is probably best controlled by Federal regulation, whereas localized pollution is probably more efficiently handled by local government regulation. In other instances, only a quantitative benefit/cost analysis can resolve the question, and the agency should include in its RIA an analysis of whether State or local government could more effectively achieve the regulatory goals. '.

BENEFIT/COST ANALYSIS

If the agency determines that Federal regulatory action is necessary, then it must also prepare a benefit/cost analysis of the selected regulatory option and other suitable alternatives.[40] There are certain elements that play a crucial role in developing an effective benefit/cost analysis for policymaking purposes.

Selection and Evaluation of Regulatory Options

Ordinarily the RIA should identify several regulatory options. One option, the status quo, normally serves as the base from which increments in benefits and costs are calculated for the other alternatives.[41] Other options the RIA should consider include varying degrees of stringency or varying dates of compliance. A failure to identify appropriate options substantially weakens the use of the RIA for decisionmaking, because it biases the analysis by effectively precluding consideration of alternatives that may be superior to the regulatory option selected by the agency.

In cases where an agency focuses on a specific "design" standard (a standard that mandates a specific technology), it should also evaluate a comparable regulatory option that achieves that same "performance" level without prescribing the method of compliance.[42] As the 1985 Regulatory Program pointed out, ". . . a regulation should focus on the goals to be achieved rather than on the specific technology or means used to achieve these goals. Setting performance standards in regulations is more efficient than specifying technological solutions (i.e., design standards) because they provide industry with the incentive to be innovative in finding the most cost-effective solutions . . . ."[43]

[38] One type of "public good"—the provision of adequate information for buyers and sellers to make informed decisions in the marketplace—may also be a source of market failure. There are costs, though, as well as benefits in collecting and providing information. As a result a market failure occurs only in cases where the benefits substantially exceed the cost of providing additional information to the market. Where market failure due to inadequate information is the rationale for government action, a regulatory action to improve the availability of information, thereby allowing individuals to make informed decisions in their own best interest, will ordinarily be the preferred alternative. Food and Drug Administration ingredient labeling requirements and EPA's hazard labeling for pesticides exemplify this type of regulation.

[39] Natural monopoly exists where a market can be served at lowest costs only if production is limited to a single producer, as in the case of local telephone, gas, and electricity services. In this case regulation of the munopoly may be desirable because an unregulated monopolist will usually charge a higher price and produce and sell a smaller quantity than the price and quantity that would emerge in a competitive industry.

[40] Occasionally the agency may be prohibited by statute from relying on benefit/cost analysis in its decision to regulate. Even in this case, however, the Executive Order requires a benefit/cost analysis in order to inform the Congress, the courts, and the public of the rule's effects.

[41] If the status quo is an existing regulation, then the RIA should consider "no regulation" as an alternative.

[42] This point follows directly from Guideline #5 in the August 11, 1983 report of the Presidential Task Force on Regulatory Relief, "Reagan Administration Regulatory Achievements" and reaffirmed by E.O. No. 12498. It is also discussed above.

[43] Regulatory Program of the United States Government: April 1, 1985—March 31, 1986, p. xv.

Benefit Estimates

The RIA should describe the beneficial effects of the proposed regulatory change and of its principal alternatives. In each case the agency should explain the way in which the proposed action is expected to yield the anticipated benefits. To the extent feasible, all potential benefits should be monetized—quantified in monetary terms (using constant dollars).[44] Any expected incremental benefits that cannot be monetized should be explained.

In developing benefits estimates the agency should: (1) clearly outline a causal link between the regulatory action and the expected benefits and (2) support its major assumptions and use sensitivity analysis (i.e., show a range of estimates) where appropriate. The identification of a causal link between the regulatory action and identified benefits is a key element of an RIA. The linkage between a regulatory action and the expected benefits of regulation frequently involves a complex sequence of steps. As a result there may be considerable uncertainty about the magnitude (and even the direction) of the effect of a regulatory action in some cases—particularly when the agency considers all the likely indirect effects as well.

Principles for Valuing Benefits

Ordinarily, goods and services should be valued at their market prices. In some instances, however, the market price of a good or service may not reflect its true value to society. If a regulatory action affects such a good or service, its monetary value for purposes of benefit/cost analysis should be derived using an estimate of its true value to society—often called its "shadow price." An example of a market price not reflecting a good's true value to society would be a commodity in a price support program where extra production is purchased by the government for storage.

Valuation of Benefits Not Traded in the Market

In some important instances a benefit does not correspond to a good or service traded in the marketplace. Important examples include reductions in health and safety risks, savings in time, and environmental amenities such as scenic vistas. To estimate the monetary value of a benefit that is not traded directly in the marketplace, the willingness-to-pay valuation approach is useful, because the amount that people are willing to pay for a good or service is often the best measure of its value to them. Willingness-to-pay estimates are derived from statstical analysis of labor or consumer markets or by using sophisticated consumer survey techniques.

Reductions in health and safety risks constitute one of the most important categories of nonmarket benefits. Both explicit and implicit methods can be used to incorporate these risk reductions into the framework of benefit/cost analysis. Among currently available methodologies, a widely accepted way to monetize explicitly reductions in fatality risks is to use the most likely estimate for the reduction in fatality risks times the willingness-to-pay estimate or the value of a unit risk reduction.[45]

An implicit valuation approach could be developed using calculations of the cost per unit of reduction in fatality risk (cost per "statistical life saved"), with costs defined as costs minus other monetized benefits.[46] Alternatives could then be arrayed in order of their total reduction in expected fatalities with the incremental cost per statistical life saved calculated between each adjacent pair of (the mutually exclusive) alternatives.

Cost Estimates

The RIA should also include a schedule of monetized costs that shows the nature of the cost and when it would occur. The numbers in this table should be expressed in constant, undiscounted dollars. Costs include private-sector compliance costs, government administrative and enforcement costs, and costs of reallocating workers displaced as a result of the regulation. Costs that are not monetary outlays—for example, discomfort or inconvenience costs—must be included and should be assigned a monetary value wherever possible.

The important economic concept of opportunity costs is as relevant to benefit-cost analysis of regulations as it is to other types of economic analysis. The opportunity cost of an alternative is the value of the

[44] The RIA should include a schedule of monetized benefits that would show the type of benefit and when it would accrue; the numbers in this table should be expressed in constant, undiscounted dollars. Moreover, the RIA should identify and explain in detail the data or studies on which benefit estimates are based. Where benefit estimates are derived from a statistical study, the RIA should provide sufficient information, so that an independent observer can determine the representativeness of the sample and whether the results were used properly in developing aggregate estimates.

[45] The willingness-to-pay approach to valuing fatality risk reductions has recently been endorsed by a report prepared for the Administrative Conference of the United States. See Clayton P. Gillette and Thomas D. Hopkins, "Federal Agency Valuations of Human Life" (July 1988). While there is extensive literature yielding estimates on the value of small reductions in fatality risk, the available literature on willingness-to-pay estimates for small reductions in the risk of nonfatal illness or injury is far more limited. As a result, the analysis should reflect the best judgment on whether a willingness-to-pay study or a direct-cost valuation (e.g., medical costs and the value of lost production) provides a better estimate of the value of reducing the risk of nonfatal illness or injury.

[46] Gillette and Hopkins, *op. cit.*, also recommend to the Administrative Conference that: "Regulations that are adopted on the justification that they will save lives should state an explicit valuation utilized, or should disclose the value per statistical life implicit in that determination" (p. 62).

should adopt cost-effectiveness analysis as a way of presenting this information in a systematic way. Unlike benefit-cost analysis, cost-effectiveness analysis does not require the monetization of benefits (although it does require the quantification of benefits).

Last year's Regulatory Program illustrated the usefulness of this type of analysis by presenting a table (reproduced here as Table I) of risk-cost tradeoffs for selected regulations from different agencies.

Once the cost-effectiveness estimates of the alternative regulatory options have been arrayed in a table, the relative merits of the alternatives considered are readily apparent. Table I shows that one million dollars spent per year in complying with OSHA's regulation on servicing wheel rims was estimated to save four "statistical lives" per year compared to two thirds of a "statistical life" every ten years for its Ethylene Oxide rule. Clearly if OSHA could mandate that only one million dollars per year of additional private resources could be spent on health and safety improvement, it would do well to consider issuing the wheel rim rule first.

The fact that Table I reveals a wide divergence in cost-effectiveness of risk-reducing regulations does not necessarily mean that regulatory oversight has failed. Not all the information necessary for fair and efficient decisions is displayed in Table I. For example, not all regulatory options are listed (only a selected sample), different parties pay the costs of and benefit from the different regulations, and other values that matter to society such as individual freedoms and basic rights are not included. Nevertheless, the wide divergence in cost-effectiveness displayed in Table I as well as other studies like it is a strong indication that there is room for improvement.[48]

SUMMARY

The analytical elements outlined above constitute the foundation of an effective and useful RIA. Adherence to these key elements will yield important improvements in the information provided to decisionmakers, resulting in better-designed regulations and potentially large net benefits to society as a whole. In addition improved analyses will help the public, Congress, and the courts understand agency regulatory decisions.

Last year's Regulatory Program started that OMB was in the process of drafting more specific guidance in preparing RIAs in order to provide continued improvements in regulatory analyses. Draft RIA guidelines are set out in Appendix V. OMB solicits comments on their completeness, usefulness, and appropriateness.

[48] Executive Order No. 12291 requires that net benefits (benefits minus costs) be calculated and that regulatory decisions be made that maximize net benefits to the extent permitted by law

[49] See John Morrall, "Regulating Risk: A Review of the Record," *Regulation* (Nov/Dec 1986) p. 30 and John Mendeloff, *The Dilemma of Toxic Substance Regulation*, (Cambridge, Mass.: MIT Press, 1988) p. 22.

APPENDIX I

Executive Order No. 12291

EXECUTIVE ORDER NO. 12291 OF FEBRUARY 17, 1981

Federal Regulation

By the authority vested in me as President by the Constitution and laws of the United States of America, and in order to reduce the burdens of existing and future regulations, increase agency accountability for regulatory actions, provide for presidential oversight of the regulatory process, minimize duplication and conflict of regulations, and insure well-reasoned regulations, it is hereby ordered as follows:

Section 1. *Definitions.* For the purposes of this Order:

(a) "Regulation" or "rule" means an agency statement of general applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the procedure or practice requirements of an agency, but does not include:
(1) Administrative actions governed by the provisions of Sections 556 and 557 of Title 5 of the United States Code;
(2) Regulations issued with respect to a military or foreign affairs function of the United States; or
(3) Regulations related to agency organization, management, or personnel.

(b) "Major rule" means any regulation that is likely to result in:
(1) An annual effect on the economy of $100 million or more;
(2) A major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions; or
(3) Significant adverse effects on competition, employment, investment, productivity, innovation, on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets.

(c) "Director" means the Director of the Office of Management and Budget.

(d) "Agency" means any authority of the United States that is an "agency" under 44 U.S.C. 3502(1), excluding those agencies specified in 44 U.S.C. 3502(10).

(e) "Task Force" means the Presidential Task Force on Regulatory Relief.

Sec. 2. *General Requirements.* In promulgating new regulations, reviewing existing regulations, and developing legislative proposals concerning regulation, all agencies, to the extent permitted by law, shall adhere to the following requirements:

(a) Administrative decisions shall be based on adequate information concerning the need for and consequences of proposed government action;

(b) Regulatory action shall not be undertaken unless the potential benefits to society for the regulation outweigh the potential costs to society;

(c) Regulatory objectives shall be chosen to maximize the net benefits to society;

(d) Among alternative approaches to any given regulatory objective, the alternative involving the least net cost to society shall be chosen; and

(e) Agencies shall set regulatory priorities with the aim of maximizing the aggregate net benefits to society, taking into account the condition of the particular industries affected by regulations, the condition of the national economy, and other regulatory actions contemplated for the future.

Sec. 3. *Regulatory Impact Analysis and Review.*

(a) In order to implement Section 2 of this Order, each agency shall, in connection with every major rule, prepare, and to the extent permitted by law consider, a Regulatory Impact Analysis. Such Analyses may be combined with any Regulatory Flexibility Analyses performed under 5 U.S.C. 603 and 604.

(b) Each agency shall initially determine whether a rule it intends to propose or to issue is a major rule, *provided that*, the Director, subject to the direction of the Task Force, shall have authority, in accordance with Sections 1(b) and 2 of this Order, to prescribe criteria for making such determinations, to order a rule to be treated as a major rule, and to require any

set of related rules to be considered together as a major rule.

(c) Except as provided in Section 8 of this Order, agencies shall prepare Regulatory Impact Analyses of major rules and transmit them, along with all notices of proposed rulemaking and all final rules, to the Director as follows:

(1) If no notice of proposed rulemaking is to be published for a proposed major rule that is not an emergency rule, the agency shall prepare only a final Regulatory Impact Analysis, which shall be transmitted, along with the proposed rule, to the Director at least 60 days prior to the publication of the major rule as a final rule;

(2) With respect to all other major rules, the agency shall prepare a preliminary Regulatory Impact Analysis, which shall be transmitted, along with a notice of proposed rulemaking, to the Director at least 60 days prior to the publication of a notice of proposed rulemaking, and a final Regulatory Impact Analysis, which shall be transmitted along with the final rule at least 30 days prior to the publication of the major rule as a final rule;

(3) For all rules other than major rules, agencies shall submit to the Director, at least 10 days prior to publication, every notice of proposed rulemaking and final rule.

(d) To permit each proposed major rule to be analyzed in light of the requirements stated in Section 2 of this Order, each preliminary and final Regulatory Impact Analysis shall contain the following information:

(1) A description of the potential benefits of the rule, including any beneficial effects that cannot be quantified in monetary terms, and the identification of those likely to receive the benefits;

(2) A description of the potential costs of the rule, including any adverse effects that cannot be quantified in monetary terms, and the identification of those likely to bear the costs;

(3) A determination of the potential net benefits of the rule, including an evaluation of effects that cannot be quantified in monetary terms;

(4) A description of alternative approaches that could substantially achieve the same regulatory goal at lower cost, together with an analysis of this potential benefit and costs and a brief explanation of the legal reasons why such alternatives, if proposed, could not be adopted; and

(5) Unless covered by the description required under paragraph (4) of this subsection, an explanation of any legal reasons why the rule cannot be based on the requirements set forth in Section 2 of this Order.

(e)(1) The Director, subject to the direction of the Task Force, which shall resolve any issues raised under this Order or ensure that they are presented to the President, is authorized to review any preliminary or final Regulatory Impact Analysis, notice of proposed rulemaking, or final rule based on the requirements of this Order.

(2) The Director shall be deemed to have concluded review unless the Director advises an agency to the contrary under subsection (f) of this Section:

(A) Within 60 days of a submission under subsection (c)(1) or a submission of a preliminary Regulatory Impact Analysis or notice of proposed rulemaking under subsection (c)(2);

(B) Within 30 days of the submission of a final Regulatory Impact Analysis and a final rule under subsection (c)(2); and

(C) Within 10 days of the submission of a notice of proposed rulemaking or final rule under subsection (c)(3).

(f)(1) Upon the request of the Director, an agency shall consult with the Director concerning the review of a preliminary Regulatory Impact Analysis or notice of proposed rulemaking under this Order, and shall, subject to Section 8(a)(2) of this Order, refrain from publishing its preliminary Regulatory Impact Analysis or notice of proposed rulemaking until such review is concluded.

(2) Upon receiving notice that the Director intends to submit views with respect to any final Regulatory Impact Analysis or final rule, the agency shall, subject to Section 8(a)(2) of this Order, refrain from publishing its final Regulatory Impact Analysis or final rule until the agency has responded to the Director's views, and incorporated those views and the agency's response in the rulemaking file.

(3) Nothing in this subsection shall be construed as displacing the agencies' responsibilities delegated by law.

(g) For every rule for which an agency publishes a notice of proposed rulemaking, the agency shall include in its notice:

(1) A brief statement setting forth the agency's initial determination whether the proposed rule is a major rule, together with the reasons underlying that determination; and

(2) For each proposed major rule, a brief summary of the agency's preliminary Regulatory Impact Analysis.

(h) Agencies shall make their preliminary and final Regulatory Impact Analyses available to the public.

(i) Agencies shall initiate reviews of currently effective rules in accordance with the purposes of this Order, and perform Regulatory Impact Analyses of currently effective major rules. The Director, subject to the direction of the Task Force, may designate currently effective rules for review in accordance with this Order, and establish schedules for reviews and Analyses under this Order.

Sec. 4. *Regulatory Review.* Before approving any final major rule, each agency shall:

(a) Make a determination that the regulation is clearly within the authority delegated by law and consistent with congressional intent, and include in the Federal Register at the time of promulgation a memorandum of law supporting that determination.

(b) Make a determination that the factual conclusions upon which the rule is based have substantial support in the agency record, viewed as a whole, with full attention to public comments in general and the comments of persons directly affected by the rule in particular.

Sec. 5. *Regulatory Agendas.*

(a) Each agency shall publish, in October and April of each year, an agenda of proposed regulations that the agency has issued or expects to issue, and currently effective rules that are under agency review pursuant to this Order. These agendas may be incorporated with the agendas published under 5 U.S.C. 602, and must contain at the minimum:

(1) A summary of the nature of each major rule being considered, the objectives and legal basis for the issuance of the rule, and an approximate schedule for completing action on any major rule for which the agency has issued a notice of proposed rulemaking;

(2) The name and telephone number of a knowledgeable agency official for each item on the agenda; and

(3) A list of existing regulations to be reviewed under the terms of this Order, and a brief discussion of each such regulation.

(b) The Director, subject to the direction of the Task Force, may, to the extent permitted by law:

(1) Require agencies to provide additional information in an agenda; and

(2) Require publication of the agenda in any form.

Sec. 6. *The Task Force and Office of Management and Budget.*

(a) To the extent permitted by law, the Director shall have authority, subject to the direction of the Task Force, to:

(1) Designate any proposed or existing rule as a major rule in accordance with Section 1(b) of this Order;

(2) Prepare and promulgate uniform standards for the identification of major rules and the development of Regulatory Impact Analyses;

(3) Require an agency to obtain and evaluate, in connection with a regulation, any additional relevant data from any appropriate source;

(4) Waive the requirements of Sections 3, 4, or 7 of this Order with respect to any proposed or existing major rule;

(5) Identify duplicative, overlapping and conflicting rules, existing or proposed, and existing or proposed rules that are inconsistent with the policies underlying statutes governing agencies other than the issuing agency or with the purposes of this Order, and, in each such case, require appropriate interagency consultation to minimize or eliminate such duplication, overlap, or conflict;

(6) Develop procedures for estimating the annual benefits and costs of agency regulations, on both an aggregate and economic or industrial sector basis, for purposes of compiling a regulatory budget;

(7) In consultation with interested agencies, prepare for consideration by the President recommendations for changes in the agencies' statutes; and

(8) Monitor agency compliance with the requirements of this Order and advise the President with respect to such compliance.

(b) The Director, subject to the direction of the Task Force, is authorized to establish procedures for the performance of all functions vested in the Director by this Order. The Director shall take appropriate steps to coordinate the implementation of the analysis, transmittal, review, and clearance provisions of this Order with the authorities and requirements provided for or imposed upon the Director and agencies under the Regulatory Flexibility Act, 5 U.S.C. 601 *et seq.*, and the Paperwork Reduction Plan Act of 1980, 44 U.S.C. 3501 *et seq.*

Sec. 7. *Pending Regulations.*

(a) To the extent necessary to permit reconsideration in accordance with this Order, agencies shall, except as provided in Section 8 of this Order, suspend or postpone the effective dates of all major rules that they have promulgated in final form as of the date of this Order, but that have not yet become effective, excluding:

(1) Major rules that cannot legally be postponed or suspended;

(2) Major rules that, for good cause, ought to become effective as final rules without reconsideration. Agencies shall prepare, in accordance with Section 3 of this Order, a final Regulatory Impact Analysis for each major rule that they suspend or postpone.

(b) Agencies shall report to the Director no later than 15 days prior to the effective date of any rule that the agency has promulgated in final form as of the date of this Order, and that has not yet become effective, and that will not be reconsidered under subsection (a) of this Section:

(1) That the rule is excepted from reconsideration under subsection (a), including a brief statement of the legal or other reasons for that determination; or

(2) That the rule is not a major rule.

(c) The Director, subject to the direction of the Task Force, is authorized, to the extent permitted by law, to:

(1) Require reconsideration, in accordance with this Order, of any major rule that an agency has issued in final form as of the date of this Order and that has not become effective; and

(2) Designate a rule that an agency has issued in final form as of the date of this Order and that has not yet become effective as a major rule in accordance with Section 1(b) of this Order.

(d) Agencies may, in accordance with the Administrative Procedure Act and other applicable statutes, permit major rules that they have issued in final form as of the date of this Order, and that have not yet become effective, to take effect as interim rules while they are being reconsidered in accordance with this Order, *provided that*, agencies shall report to the Director, no later than 15 days before any such rule is proposed to take effect as an interim rule, that the rule should appropriately take effect as an interim rule while the rule is under reconsideration.

(e) Except as provided in Section 8 of this Order, agencies shall, to the extent permitted by law, refrain from promulgating as a final rule any proposed major rule that has been published or issued as of the date of this Order until a final Regulatory Impact Analysis, in accordance with Section 3 of this Order, has been prepared for the proposed major rule.

(f) Agencies shall report to the Director, no later than 30 days prior to promulgating as a final rule any proposed rule that the agency has published or issued as of the date of this Order and that has not been considered under the terms of this Order:

(1) That the rule cannot legally be considered in accordance with this Order, together with a brief explanation of the legal reasons barring such consideration; or

(2) That the rule is not a major rule, in which case the agency shall submit to the Director a copy of the proposed rule.

(g) The Director, subject to the direction of the Task Force, is authorized, to the extent permitted by law, to:

(1) Require consideration, in accordance with this Order, of any proposed major rule that the agency has published or issued as of the date of this Order; and

(2) Designate a proposed rule that an agency has published or issued as of the date of this Order, as a major rule in accordance with Section 1(b) of this Order.

(h) The Director shall be deemed to have determined that an agency's report to the Director under subsections (b), (d), or (f) of this Section is consistent with the purposes of this Order, unless the Director advises the agency to the contrary:

(1) Within 15 days of its report, in the case of any report under subsections (b) or (d); or

(2) Within 30 days of its report, in the case of any report under subsection (f).

(i) This Section does not supersede the President's Memorandum of January 29, 1981, entitled "Postponement of Pending Regulations," which shall remain in effect until March 30, 1981.

(j) In complying with this Section, agencies shall comply with all applicable provisions of the Administrative Procedure Act, and with any other procedural requirements made applicable to the agencies by other statutes.

Sec. 8. *Exemptions.*

(a) The procedures prescribed by this Order shall not apply to:

(1) Any regulation that responds to an emergency situation, *provided that*, any such regulation shall be reported to the Director as soon as it is practicable, the agency shall publish in the *Federal Register* a statement of the reasons why it is impracticable for the agency to follow the procedures of this Order with respect to such a rule, and the agency shall prepare and transmit as soon as is practicable a Regulatory Impact Analysis of any such major rule; and

(2) Any regulation for which consideration or reconsideration under the terms of this Order would conflict with deadlines imposed by statutes or by judicial order, *provided that*, any such regulation shall be reported to the Director together with a brief explanation of the conflict, the agency shall publish in the *Federal Register* a statement of the reasons why it is impracticable for the agency to follow the procedures of this Order with respect to such a rule, and the agency, in consultation with the Director, shall adhere to the requirements of this Order to the extent permitted by statutory or judicial deadlines.

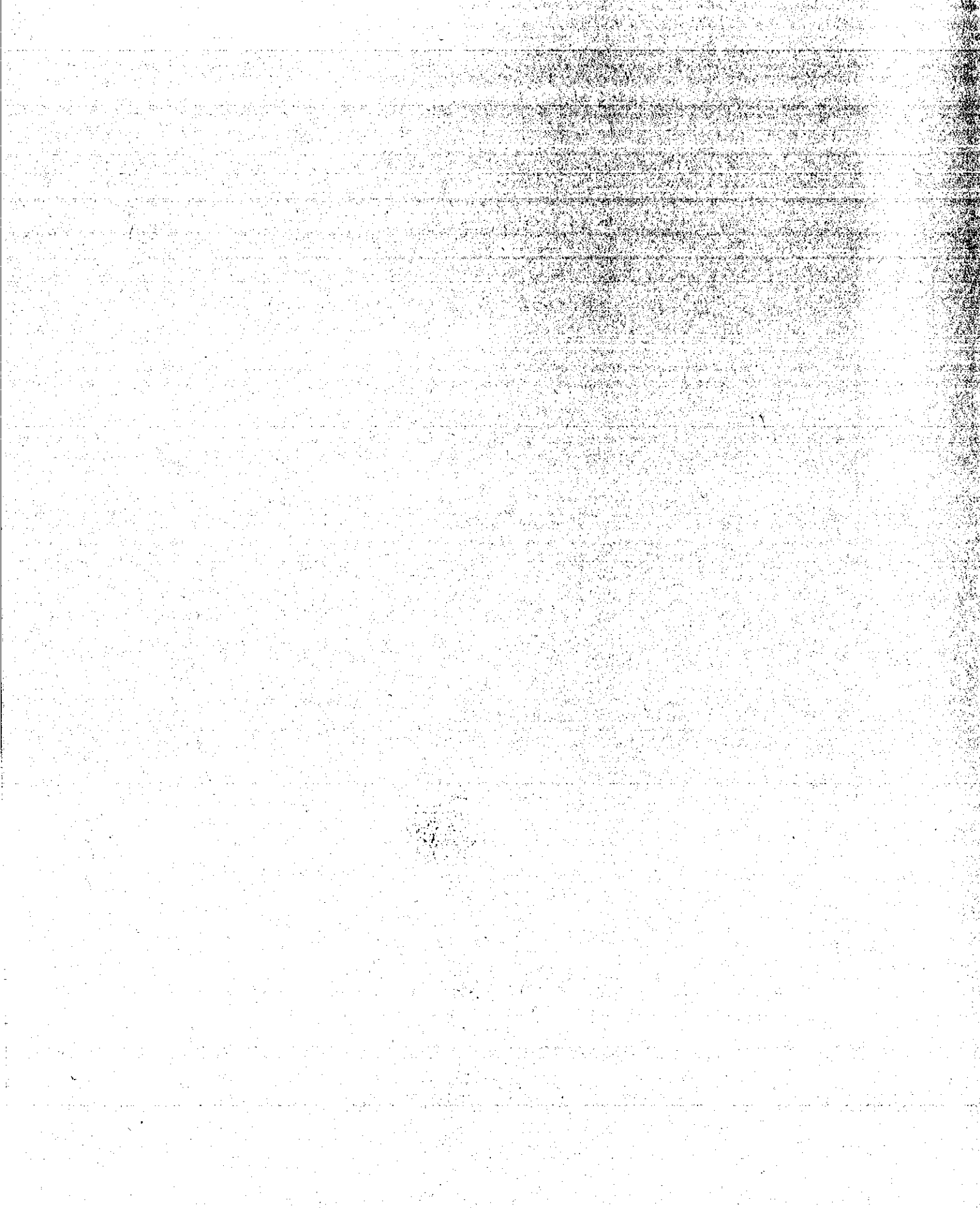
(b) The Director, subject to the direction of the Task Force, may, in accordance with the purposes of this Order, exempt any class or category of regulations from any or all requirements of this Order.

Sec. 9. *Judicial Review.* This Order is intended only to improve the internal management of the Federal government, and is not intended to create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its agencies, its officers or any person. The determinations made by agencies under Section 4 of this Order, and any Regulatory Impact Analyses for any rule, shall be made part of the whole record of agency action in connection with the rule.

Sec. 10. *Revocations.* Executive Orders No. 12044, as amended, and No. 12174 are revoked.

RONALD REAGAN

THE WHITE HOUSE
February 17, 1981



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Report for
RECOMMENDATION 88-7

FEDERAL AGENCY VALUATIONS OF HUMAN LIFE

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I. Introduction

Regulation of health and safety hazards provides protection at a price. Using regulation to decrease the number or severity of accidents, injuries, and illnesses typically requires the expenditure of societal resources. Notwithstanding the benefits that can be conferred by these expenditures, the limited nature of available resources means that their dedication to this purpose requires forgoing alternative uses. Thus, decisions to take advantage of an opportunity for risk reduction necessarily confronts the issue: is the reduction worth the cost? Put in the extreme, this question asks what we as a society are willing to invest in order to save lives, or -- more crudely -- what price we place on human life. As harsh or cold-blooded as this inquiry might seem, it is both a common and necessary part of government regulation of hazards.

The inevitability of this issue does not suggest, however, that all regulators will define the "value of life" equally or even similarly. Indeed, there is substantial evidence that federal agencies differ widely on life valuation questions that determine the propriety of a particular regulation. Some agencies employ explicit valuations of life in determining the relative benefits of a proposed regulation, while other agencies eschew any such calculation. Even the latter, of course, reveal an implicit value that can be inferred by computing the cost of a regulation and the number of lives that would be saved through its adoption. Our discussions with agency officials suggest that where explicit figures are used there recently has been convergence around a figure of $1-2 million per statistical life. For instance, economists at the Consumer Product Safety Commission utilize that range.[1] Nevertheless, agencies have used substantially varying numbers in calculating the benefits of particular regulations. EPA staff have employed figures between $400,000 and $7 million.[2] The Nuclear Regulatory Commission has adopted a somewhat different approach; it evaluates the "value-impact" of proposed regulations by assigning a monetary value of $1000 per person-rem that would be averted by a given proposal.[3] By one calculation, NRC's figure translates into $7.4 million per fatality averted.[4]

Agencies that do not adopt explicit values of life may still predict both the cost of implementing a proposed regulation and the number of lives that would thereby be saved. The implicit cost of regulation per life saved derived from these figures permits some inference about the value of life assumed in agency action or inaction. For example, the Office of Management and Budget[5] has documented values per life saved in discrete rulemakings ranging as low as $70,000 (in a 1980 Consumer Product Safety Commission regulation of space heaters) and as high as $132,000,000 (in a 1979 regulation of the Food

1 See, e.g., Memorandum from Paul Rubin to L.J. Sharman, May 27, 1987.
2 Conversation of authors with Ralph A. Luken, Chief, Economic Studies Branch, Environmental Protection Agency.
3 See 10 C.F.R. §50, Appendix I; Division of Risk Analysis, Office of Nuclear Regulatory Research, Nuclear Regulatory Commission, A Handbook for Value-Impact Assessment 3-15 (1983).
4 Spangler, Trans-Scientific Issues in Risk-Cost-Benefit Analysis of Energy Options 13 (unpublished manuscript 1985). An earlier NRC report translated the person-rem standard into a wider range of $4 million to $100 million depending on assumptions made. See NUREG - CR2899, Analysis of a Proposed $1000 Per Man Rem Cost Effectiveness Criterion (1982).
5 See Office of Management and Budget, Regulatory Program of the United States Government, 1987-1988 xx (hereinafter "OMB").

and Drug Administration banning DES in cattle feed). Were decisions to regulate based on a strict comparison of costs and benefits, adoption of the CPSC regulation would imply that the agency valued life at a figure *no less* than $70,000 while rejection of the FDA regulation would imply a valuation of *no greater* than $131,999,999. In another investigation of rulemakings concerning environmental carcinogens at four agencies -- Environmental Protection Agency, Consumer Product Safety Commission, Occupational Safety and Health Administration, and Food and Drug Administration -- researchers found that, at least in this important class of health regulation, we as a society tend to regulate vigorously if lives can be protected at less than $2 million per life saved, but not if costs are significantly higher.[6]

Standing alone, variation in implicit or explicit values is not necessarily troublesome. As we discuss later in this report, different circumstances may justify the use of different valuations of lives. More problematic, however, is a divergence among agencies in the effort expended to derive a meaningful calculus of factors to be used in determining whether regulatory costs are justified, given the resulting savings of lives. Although some agencies -- notably EPA[7] and the Federal Highway Administration[8] -- have commissioned extensive studies that seek to draw on and expand existing knowledge about life valuation, our research reveals less intense documentation efforts at the vast majority of agencies. Some agencies appear willing to accept a figure, notwithstanding the absence of independent evaluation of its veracity or its application to the borrowing agency's regulatory task.[9]

Given the range of figures and methodologies employed in the valuation of human life, there is justifiable concern that selections are based on the regulator's predisposition about a proposal's desirability rather than on the merits. Certainly valuations can be set purposefully as one of several criteria guiding decision makers. For instance, Viscusi, in surveying available normative studies of life valuation, found that (depending on the particular circumstances) plausible justifications are available for values from $600,000 (where individuals place themselves voluntarily in high risk situations) to $7 million (where risks are involuntary and remote).[10] Recent reviews of valuation studies support a range of $1.6 to $8.5 million.[11] But, of course, value of life outcomes also may be a by-product of decision making that is guided by other considerations entirely. Indeed, as we shall see,

6 Travis et al., Cancer Risk Management: A Review of 132 Federal Regulatory Decisions, 21 Environmental Science and Technology (1987).
7 See EPA, Valuing Reductions in Risks: A Review of the Empirical Estimates -- Summary (1983).
8 See Federal Highway Administration, Alternative Approaches to Accident Cost Concepts -- State of the Art (1984).
9 In hearings concerning EPA's asbestos regulations, Jack Campbell, Deputy Assistant Administrator for Policy, Planning, and Evaluation at EPA, stated: "The $1 million per life saved figure is in essence an arbitrary figure in any (regulatory) analysis, and it is used basically as a baseline to judge whether there are positive or negative net benefits to society as a result of a particular action." EPA's Asbestos Regulations, Hearings Before the Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, 99th Cong., 1st Sess., April 16, 1985, at 455.
10 See Viscusi, The Valuation of Risks to Life and Health: Guidelines for Policy Analysis 201-02 n.5, in J. Bentkover et al., Benefits Assessment: The State of the Art (1986).
11 Fisher, Chestnut, & Violette, The Value of Reducing Risks of Death: A Note on New Evidence (forthcoming).

some argue that such numbers are largely devoid of meaning and, in any event, repugnant or irrelevant.

Why life saving values differ across types of rulemakings and agencies, whether they should vary, and the propriety of the manner in which agencies derive and utilize them comprise the focus of this report. We begin in Section II with a discussion of the Executive Orders and statutory and case law that define the parameters for agency valuation practices. Section III then turns to a broad array of issues that arise in the valuation process, including philosophical reservations about any explicit valuation efforts and more pragmatic questions concerning valuation techniques. Finally, Section IV provides our concluding observations and recommendations for improvements in agency practice.

One final caveat is necessary before we proceed to the substance of this study. Our inquiry is to determine how human life is and ought to be valued on those occasions when federal agencies determine such calculations to be desirable. We are not here concerned with defining the circumstances under which consideration of the value of human life should be an integral part of agency decision making. As we indicate in the next section, that determination requires analysis of applicable case law, statutes, and executive orders. Our recommendations speak only to those situations in which an agency has determined, based on one of these independent mandates, that the value of human life is a necessary or useful variable in a policy decision. Additionally, we are not here concerned with the propriety of particular modes of analysis in which the value of human life may be a factor. Specifically, we do not seek to re-enter the continuing debate over the use of a strict cost-benefit analysis with respect health and safety regulation. We seek instead to recognize that under several modes of analysis it may be helpful to assign some value to human life. For instance, even if one rejects the proposition that environmental decision making should be predicated exclusively on a comparison of monetized costs and benefits, attention to monetized values may be useful to determine whether conclusions reached on the basis of other variables deviate significantly or only minutely from conclusions that would be reached through a cost-benefit calculation. Nevertheless, we recognize that, for some, any discussion of monetized values for human life conjures images of mechanistic or amoral decision making. Thus, we wish to indicate strongly at the outset that our attention to the question of valuation does not necessarily entail endorsement of any particular procedure for ultimate determinations of the desirability of regulation. We do believe that valuation of life provides data that can be considered in any such determination. It is for the political process to ascertain the variables ultimately considered in any decision concerning regulation. The credibility of any such conclusion, however, depends on the reliability and availability of the underlying information. For that reason, it is essential that the methods used for valuation of human life be as complete and open as possible. It is with that end in view that we proceed.

II. Legal Bases for Agency Valuation of Human Lives.

Administrative agencies that possess statutory authority to promulgate health and safety regulations face a variety of constraints on what and how they may regulate. The most obvious and direct of these are contained in certain generic laws such as the Administrative Procedure Act[12] and in each agency's organic statute. While the generic laws are silent on life valuation matters, a number of specific statutes limit and guide agencies in ways that affect any attempt to value human life, as discussed in Section II.B. We also examine in that section an additional array of life valuation constraints appearing in judicial decisions. First, however, we review in Section II.A the tier of requirements that

12 5 U.S.C. §§ 551-59, 701-06, 3105, 3344, 5362, 7521.

has emanated from the executive branch and been superimposed on the more traditional statutory and judicial constraints.

A. Overview of Executive Orders Mandating Cost/Benefit Analysis and Associated OMB Guidance

Most statutes allow agencies considerable discretion in the design and implementation of new regulations. Such agency discretion is substantially narrower where the Congress specifically designates the regulatory action to be taken by an agency, but congressional intervention in the minutiae of implementation is uncommon. In the main, Congress provides fully detailed mandates only where it lacks confidence in prior (as with NHTSA's auto ignition/seat belt interlock regulation) or expected (as with deadlines imposed to accelerate some EPA regulation) agency conduct. Even then, however, agencies are left with responsibility for a host of practical decisions that usually prove necessary to translate a statutory design into an implemented regulation. Thus, managing the regulatory process requires much agency judgment, often extending to basic decision criteria and priorities in addition to the unavoidable details of implementation.

When Congress delegates to an administrative agency the duty to regulate a health or safety problem, it typically is expressing its intent that the agency's specialized expertise guide regulatory action.[13] The Congress, that is, looks to the head of the designated agency, and not to the President, for the solution to a problem. This creates a natural tension, or at least an added decision complexity, for those agencies that are subject to White House supervision (i.e., those agencies whose heads serve at the pleasure of the President). For inherent in the executive function of the Presidency is the obligation to ensure the faithful execution of the law, which unavoidably entails responsibility for agency exercise of discretion.[14]

Recent administrations have taken progressively increased cognizance of this authority and have used it to structure regulation in a manner consistent with broad political objectives. A White House managerial process has evolved to guide agency use of whatever discretion exists in the regulatory statutes. The Reagan Administration in particular has made vigorous use of the Executive order mechanism and of the 1980 Paperwork Reduction Act in managing the issuance of regulations. It has articulated a distinctive set of regulatory principles and established a more potent central oversight process than existed previously.

The current process grew out of several years of experimentation with shifting White House review mechanisms.[15] The most noteworthy antecedent prior to 1974 was the "Quality of Life Review" process started in 1971 by the Office of Management and

13 See DeMuth & Ginsburg, White House Review of Agency Rulemaking, 99 Harv. L. Rev. 1075, 1077-79 (1986) (arguing that deference to agencies furthers the objective of efficient rulemaking).

14 See, e.g., Sierra Club v. Costle, 657 F.2d 298, 405-07 (D.C. Cir. 1981).

15 The following discussion of the 1975-81 period is drawn from Hopkins, Social Policy and the Regulatory Process: A 1986 Working Paper of the Project on the Federal Social Role. See also, Baram, Cost-Benefit Analysis: An Inadequate Basis for Health, Safety, and Environmental Regulatory Decisionmaking, 8 Ecol. L. Q. 473, 502-15 (1980); OMB, supra note 5.

Budget.[16] Motivated principally by concern about rising budgetary and industrial compliance costs of new environmental regulations, OMB Director George Shultz signed memoranda directing agencies to submit significant regulatory proposals to OMB for review. In practice, this review process focused on proposals from only one agency, the Environmental Protection Agency. The process involved interagency meetings, convened by OMB, at which EPA defended its intended actions in a hostile forum dominated by staff from OMB and the Department of Commerce. This mechanism had narrow scope and dubious authority, but it continued to operate until 1977, when EPA declared that it would no longer participate.

Starting well before 1977, however, the Quality of Life Review process came to be superseded gradually by oversight mechanisms with stronger legal footholds. In 1974, President Ford signed the first of what has turned out to be a very significant series of Executive Orders on the regulatory process. As it came to be implemented, his 1974 Executive Order 11821 required that those agencies whose heads serve at the pleasure of the President prepare an Inflation Impact Statement ("IIS") for every new regulation likely to have a substantial economic effect. Although the Office of Management and Budget approved several different criteria for agencies to use in deciding which regulations would have large enough effects to warrant an IIS, the standard most heavily relied on involved aggregate compliance costs imposed on those regulated in excess of $100 million in any single year.

The IIS was to include a full appraisal of the benefits and costs of the rule relative to those of promising alternatives, but the agency did not have to base its decisions about design or issuance of the rule on the IIS, or even use it in the decision process. An inadequate (or non-existent) IIS posed no direct legal problems, and afforded private parties no new grounds for litigation. The courts saw it as an internal managerial tool clearly within the discretion of the President to apply as he saw fit.[17]

Essentially the IIS analysis provided contending interests added targets or support and served as a key resource for White House overseers. During its seven-year existence (1974-81), the Council on Wage and Price Stability ("CWPS"), which served as the principal regulatory monitoring unit within the Executive Office, used the IIS to shift the regulatory debate toward efficiency concerns. (The initial labels did not suggest this emphasis; indeed, both the IIS and the creation of the CWPS had reflected renewed worry about inflation.) With no powers to coerce, the CWPS' influence derived from its access to agency decision makers and its broad statutory authority[18] to issue public statements on pending rulemaking proceedings.

The efficiency perspective advocated by CWPS gradually came to be accepted as legitimate and potentially powerful. During the Ford Administration, CWPS prepared and publicized policy papers sharply critical of many regulatory proposals. This stimulated greater public debate and increasingly put regulators on the defensive. In response, some regulators began to take the IIS requirements much more seriously, seeking to explain more explicitly the economic effects of their proposals. Near the end of the Ford Administration, Executive Order 11949 changed the IIS label to Economic Impact Statement to reflect its new focus.

16 See Eads & Fix, Relief or Reform? 46-50 (1980); National Academy of Public Administration, Presidential Management of Rulemaking in Regulatory Agencies 9 (1987).
17 See, e.g., Meat Packers Assn. v. Butz, 526 F.2d 228, 234-36 (8th Cir. 1975), cert. denied 424 U.S. 966 (1976).
18 See P.L. 93-387, §3(a)(7).

The incoming Carter Administration, after more than a year of debate about the CWPS program, decided to continue the CWPS with basically the same role on regulatory matters, and to create a new player, the Regulatory Analysis Review Group ("RARG"). Chaired by the Council of Economic Advisers, the RARG provided a forum for executive branch agencies to discuss the economic analysis of 10 to 20 key regulatory proposals each year. While many agencies were RARG members, it was dominated by staff drawn from units of the Executive Office of the President who were skeptical of traditional regulation.

A new Executive Order (12044) was issued in 1978, replacing President Ford's Executive Order 11949. The analysis required for major new regulations under this order was renamed Regulatory Analysis ("RA") and slightly recast. Each RA was to contain

> a succinct statement of the problem; a description of the major alternative ways of dealing with the problem that were considered by the agency; an analysis of the economic consequences of each of these alternatives and a detailed explanation of the reasons for choosing one alternative over the others.[19]

The Executive Order also added a number of features to regulatory oversight, including a semiannual agenda alerting the public to all nontrivial rules under development, and tighter management of the major rule analysis process. RA's were to be issued in draft form at the rule proposal stage and in final form when the rule was promulgated.

Noteworthy by its absence from the Carter Executive Order was any reference to "benefit cost analysis," which Administration officials thought many perceived as unbalanced and anti-regulatory, in that the less readily quantifiable social benefits would be slighted by cost-benefit analysts. Yet the distinction between that mode of analysis and the "analysis of the economic consequences of . . . alternatives" required for an RA is largely one of semantics and emotions.

The Ford Executive Order had called for cost-benefit analysis to be performed but was silent on how if at all that analysis would be used in actual decisionmaking. The Carter Executive Order moved toward requiring some use of analysis in making decisions, however cautiously: each agency was to select, in any manner it wished, alternative actions it found acceptable; it then was directed to adopt the least burdensome of these alternatives.

Under the leadership of CEA and, to some extent, OMB, the Carter program featured extensive consultation among agencies intended to reach consensus on the analysis and shaping of key regulatory proposals. However, OMB drew narrow limits around its role in this process: "...for OMB to approve or provide appellate review of the substance of individual regulations would be inappropriate and counter to the emphasis on agency accountability in the Executive Order."[20] The consultations held under RARG auspices produced, for each of the small number of regulatory proposals reviewed, a public report that, as a consensus document, was perhaps less strident than many CWPS reports of the Ford period. But in any event such reports continued to be merely advisory.

Within weeks of President Reagan's inauguration, Executive Order 12291[21] made cost-benefit analysis a key determinant of agency decisions, and assigned pre-clearance responsibilities to OMB -- in both cases, to the extent permitted by law. Major regulations

19 Executive Order 12044, §3(b)(1).
20 43 Fed. Reg. 126691.
21 Reprinted in 5 U.S.C. §601 (Supp. 1988).

continued to face an economic analysis requirement, now renamed Regulatory Impact Analysis (RIA). OMB assumed expanded oversight duties that had previously been shared by CWPS and RARG, both of which were eliminated in 1981.

The Reagan regulatory principles declare that, to the extent permissible under law, regulation should satisfy two primary criteria. First, regulation would be utilized only where it would resolve a problem more effectively than would market forces. Second, regulation was to be structured to maximize net benefits to society. This position, articulated initially in Executive Order 12291, has been amplified in subsequent White House documents,[22] including most notably in the Regulatory Program of the United States Government, April 1, 1987-March 31, 1988. On the theory that one can only determine whether net benefits are maximized through the use of cost-benefit analysis, the Reagan regulatory principles constitute an endorsement of that particular analytical tool.[23]

This Presidential requirement for the use of cost-benefit analysis in regulatory decisionmaking, except where precluded by statute, necessarily carries with it an understanding that those lives at stake in regulatory outcomes will be evaluated in some fashion. Otherwise, any calculation of a regulation's net benefits will exclude what often is its most fundamental objective -- lessening the risk of fatalities. An estimate of the net benefits of a health or safety regulation that takes into account factors such as property damage averted, medical costs avoided, and compliance burden imposed certainly will be misleading and incomplete unless it also includes some valuation of fatalities prevented or of life-years extended.

The Executive Order and related documentation recognize that not all effects of a regulation can be translated into a dollar metric, but they do establish a presumption that much can be accomplished in presenting more comprehensive dollar measurements of both benefits and costs. The concept of net social benefits found in the Reagan regulatory principles is a broad one. It includes any consequence of a regulation that alters the level of material affluence or welfare. Some such consequences are difficult or impossible to measure unambiguously -- e.g., the climate for innovation -- while others can be measured by physical attributes that are difficult at best to convert into dollar terms -- e.g., miles of cleaner waterways. The message conveyed by the Reagan principles is that agencies should attempt to go further than they did previously in quantifying all such effects, whether benefits or costs, and in expressing these effects in dollar terms. The contention is that such explicitness will facilitate arriving at optimal policy decisions.

Once an agency has pushed quantification and monetization of regulatory effects as far as is practicable, the Reagan principles require presentation of its conclusions about net benefits in a way that will not slight those effects that cannot be monetized. There of course always is a temptation for the reader of a partly quantitative and partly narrative analysis to be overly swayed by the former. Nonetheless, the current Administration's principles do not on their face condone disregard of qualitative effects.

As to human life, two obvious questions arise in connection with current regulatory principles. When a regulatory initiative is being contemplated to lessen a health or safety hazard, with what confidence can the agency estimate the number and time pattern of fatalities avoided or deferred? And what, if any, monetary value can be placed on this reduction in fatality risk? The former question is left entirely to the regulatory agency to address; the White House merely encourages the agency to go as far as it prudently can in

22 See, e.g., Executive Order 12498, reprinted in 5 U.S.C. §601 (Supp. 1988).

23 See, DeMuth & Ginsburg, supra note 13.

making such estimates. The latter also is largely -- but not entirely -- delegated to the individual agencies.

As the chief player in the Presidential regulatory oversight process, OMB does not endorse any particular number as a suitable statistical value of life for agency cost-benefit analyses. And other White House participants, most notably the Vice President in his capacity as chair of the Presidential Task Force on Regulatory Relief, have distanced themselves from placing any numerical value on human life. There are large political problems -- to say nothing of the philosophical and economic issues -- associated with appearing to assert that a human life can be reduced to a particular dollar value. Explanations that the value is established for analytical purposes and is for a statistical life (or for a measurable though small reduction in the risk of fatality) are insufficiently saleable to avert political damage.

Nonetheless, OMB has an important influence on how agencies do value life in their Regulatory Impact Analyses (the formal analysis that the Executive Order requires for every major regulatory initiative). That influence derives in part from generic guidance offered agencies by OMB on a hortatory basis and in part from the OMB regulatory clearance process. As to generic guidance, the opening sections of the Regulatory Program issued by the White House in the spring of 1987 contain considerable discussion of what OMB views to be the soundest methodology for selecting statistical values of life, as well as evaluative commentary on the range of life values implicit in several agencies' regulatory decisions. That preferred methodology, discussed more fully in Section III.B of this report, is usually termed willingness-to-pay, and is based typically on labor market studies of wage variation across jobs that present differing levels of risk. While this procedure has not led OMB to endorse a particular value for human life, our interviews with staff of that agency indicate they they would generally accept regulations that cost out to less than $2 million per life, but would look askance at regulations that required expenditures much in excess of that figure.

The regulatory clearance process is also an important avenue through which OMB influences agency valuation decisions. Under the 1981 Executive Order, virtually every regulatory proposal (from any agency subject to Executive Order jurisdiction) must be reviewed by OMB at two (or more) junctures before it takes effect. Moreover, Executive Order 12498, issued in 1985, provides that, for all important contemplated regulations, agencies are to consult with OMB prior to beginning work on their design, and out of that consultative process emerges an annual publication of Administration-endorsed regulations under development.

Before an agency publishes a covered regulation in proposed form to obtain public comment (even those too minor to warrant inclusion in the Regulatory Program), it must secure OMB review. At this point, OMB is in a position to object to any aspect of the draft proposal, including whatever value of life the agency may be utilizing in its analysis supporting the proposal. On occasion, disagreement over this value reportedly has been sharp and has led to delay. Under certain circumstances, OMB can block an agency from proceeding until it satisfies OMB that the proposal is consistent with the President's regulatory principles. Finally, before an agency can publish any regulation in final form, it must again go to OMB for a further review round. Thus OMB has ample opportunity -- both on and off the record -- to communicate its views to the regulatory agency on the suitability of any particular value of life.

Not all health and safety regulation encounters this manner of OMB review, because not all regulatory agencies are obliged to conform to Executive Order requirements. Traditionally, the "independent" agencies, whose heads are not subject to Presidential

removal, have regarded themselves as exempt from the kind of OMB review discussed above. OMB has a negligible influence on such agencies' practices in valuing life, although some have adopted analytical approaches quite consistent with the basic Executive Order (e.g., the Nuclear Regulatory Commission's internal requirements for economic analysis correspond quite closely with that established by OMB).

Nonetheless, there is one important respect in which OMB does influence regulation at independent agencies. Under the Paperwork Reduction Act of 1980, no agency (independent or otherwise) can enforce a new regulation containing paperwork requirements (information collection elements) until it has obtained OMB concurrence. It is possible but not likely that issues touching on life valuation have important bearing on this OMB/agency interaction, which turns mainly on questions of the reasonableness of the time necessary to supply the information mandated.

Constraints of Statutory and Case Law

The executive branch's endorsement of cost-benefit analysis has not achieved universal acceptance within the legislative and judicial branches. Nevertheless, these branches must often wrestle with the issue of whether a particular regulatory effort is appropriate or authorized. Even if these inquiries are not answered by reference to a strict cost-benefit analysis, some consideration of the relevant adverse and positive effects of the proposed regulation would appear necessary for a rational decision. For instance, assume that we must choose between two methods of implementing a program (e.g., a program of vaccination against an anticipated epidemic), each of which would save the same number of lives, but each of which would also produce some new level of risk. The first would present a low level risk (e.g., short term, non-fatal disease due to vaccination) to numerous persons. The second would produce a high level risk (death) to a very small number of persons (e.g., those with severe abreactions) and produce no adverse reactions for anyone else. Can it be said to be illogical or unethical to consider expected losses of each policy in trying to determine which one is superior? Any such process, however, at least implicitly places a value on the lives saved or expended in the decision whether or how to regulate.

The need for agencies generally to balance the positive and negative effects of a proposed regulation -- and hence to evaluate the worth of human life -- is apparent from an examination of the statutes that authorize agency intervention. Most of these statutes confer on administrators some discretion in determining whether to promulgate a particular regulation, but constrain that discretion by reference to regulatory effects on human welfare. These constraints, however, typically are not expressed in terms of an explicit cost-benefit analysis.

In rare cases congressional standards for regulatory action are sufficiently specific that an agency need only determine whether the congressional judgment has been satisfied. Thus, a statute that requires specific agency action when a calculable threshold is passed does not confer on the agency any discretion to determine whether that particular standard is reasonable, necessary, or useful. The agency need strike no balance in which human life would be a necessary factor. Similarly, if congressional judgment required regulation as long as any threat to human life existed, computation of human life values would be unnecessary. Any threat to life would be considered too substantial, so the monetized value of benefits preserved through regulation would be irrelevant. The most celebrated instance of such a provision may be found in the Delaney Clause of the Federal Food, Drug, and Cosmetic Act.[24] The Clause prohibits the use as a food additive, animal drug,

24 21 U.S.C. §§301 - 92.

or color additive of any substance found to induce cancer in humans or animals.[25] No threshold finding is required; when it comes to cancer, the specified additives and drugs are expected to produce zero risk.

Alternatively, statutes may go so far as to require explicitly that costs and benefits of proposed agency action be compared before any regulation proceeds.[26] These provisions indicate congressional realization that achieving zero risk is infeasible; at some point the costs of further risk reduction will not be worth the attendant benefits. Thus, regulation depends on some comparison of the two. Since much regulation returns substantial benefits to human welfare in the form of lessened mortality and morbidity rates, a meaningful determination of relative costs and benefits requires that some value be assigned to these welfare effects so that they properly can be incorporated into the calculus.

More frequently, however, congressionally granted authority confers on agencies substantial discretion in the decision to regulate. This discretion may be bounded by standards such as "reasonableness" that permit, but do not expressly require the agency to engage in some sort of comparison of costs and benefits of a proposed regulation in determining its effects on human welfare. For instance, the Federal Insecticide, Fungicide, & Rodenticide Act (FIFRA)[27] permits the Administrator of the Environmental Protection Agency to take protective action with respect to a pesticide that causes "unreasonable adverse effects" on the environment.[28] Similarly, the Atomic Energy Act[29] requires the Nuclear Regulatory Commission to ensure that production of nuclear material will provide "adequate protection" to the health and safety of the public;[30] and the Federal Highway Administration is empowered to publish "reasonable rules" for the safe operation of motor carriers, e.g., driver qualifications, maximum hours, and equipment standards.[31] The Motor Vehicle Safety Act[32] requires that motor vehicle safety standards be "practicable, "[33]

25 21 U.S.C. §§348(c)(3)(a), 360b(d)(1)(H), 37b(b)(5)(B). Richard Merrill suggests that the Delaney Clause is less inclusive or absolute than the debate surrounding its propriety would suggest. See Merrill, Risk-Benefit Decisionmaking by the Food and Drug Administration, 45 Geo. Wash. L. Rev. 994, 998 (1977). On the difficulty of administering such a specific standard, see Merrill, FDA's Implementation of the Delaney Clause: Repudiation of Congressional Choice or Reasoned Adaptation to Scientific Progress?, 5 Yale J. Reg. 1 (1988).

26 See, e.g., Consumer Product Safety Act § 9(f), 15 U.S.C. §2058(f); Federal Hazardous Substances Labeling Act §3, 15 U.S.C. § 1262(i). The Clean Air Act, 42 U.S.C. §§7401- 7642, requires a benefit-cost analysis for any regulation intended to control the effectiveness of motor vehicle fuel emission control systems. See 42 U.S.C. §7545(c)(2)(B).

27 7 U.S.C. §§136 - 136y.

28 7 U.S.C. §136d(b).

29 42 U.S.C. §§2011-2296.

30 42 U.S.C. §2232(a). This provision has been construed in Union of Concerned Scientists v. Nuclear Regulatory Commission, 824 F.2d 108 (D.C. Cir. 1987), discussed at text accompanying notes 57 - 61 infra.

31 49 U.S.C. §§304(a), (e).

32 15 U.S.C. §§1391-1431.

33 15 U.S.C. §1392.

a term that the Department of Transportation suggests requires consideration of both technological and economic soundness.[34]

Most of the statutes that are administered by the EPA similarly invite, but do not compel, attention to some of the elements of a cost-benefit analysis.[35] For instance, the agency interprets the statutory directive concerning primary National Ambient Air Quality Standards[36] to permit attention only to public health, and thus EPA sets these standards without consideration of analyses that evaluate costs or nonhealth benefits.[37] The agency, however, interprets the statutory mandate concerning establishment of performance standards for new stationary sources of pollution as requiring consideration of costs, but not air quality benefits. Thus, EPA sets the relevant standards after consideration of costs, cost-effectiveness, and economic impacts and not air-quality-related benefits.[38] Alternatively, EPA believes that it is permitted to consider all aspects of cost-benefit analysis in determining standards under the Uranium Mill Tailings Radiation Control Act, an amendment to the Atomic Energy Act. That broad-ranging amendment requires EPA to consider the risk to the public health, safety, and the environment, the environmental and economic costs of applying such standards and such other factors as the Administrator determines to be appropriate."[39]

Judicial solicitude for strict agency cost-benefit analysis in the absence of an explicit legislative requirement was tested in a duet of Supreme Court cases, Industrial Union Department v. American Petroleum Institute[40] (the Benzene Case), and American Textile Mfrs. Inc. v. Donovan (the Cotton Dust Case).[41] In each case, the Court was considering whether standards promulgated by the Occupational Safety and Health Administration (OSHA) satisfied the statutory obligation of that agency to assure "to the extent feasible" that no employee would suffer material impairment of health or functional capacity.[42]

In the Benzene case, the Court considered whether a statutory directive that OSHA standards assure, as far as possible, that employees not be impaired by exposure to hazards precluded any cost-benefit analysis in the formulation of regulations. The agency had determined that, in the case of exposure to the carcinogen benzene, this directive required the most stringent limitation that was technologically and economically possible. Thus, cost-benefit analysis was unnecessary, if not outright prohibited. The Supreme Court, however, affirmed a determination by the Fifth Court of Appeals that some relationship between costs and benefits had to be made. While no opinion garnered a majority of the high court, a plurality did determine that the issue of how protective a standard should be

34 Letter of April 2, 1979, from Linda Heller Kamm, Department of Transporation, Office of General Counsel, to Ron Lewis.
35 See Environmental Protection Agency, EPA's Use of Benefit-Cost Analysis: 1981-1986 at 3-1 - 3-7 (August 1987).
36 Clean Air Act §109(b)(1).
37 EPA, supra note 7, at 3-3.
38 Id.
39 Public Law 97-415, January 4, 1983. See EPA, supra note 7, at 3-7. EPA may consider all aspects of cost-benefit analysis under the similarly broad language of the Toxic Substances Control Act, 15 U.S.C. §§2601-2629, which permits consideration of health and environmental effects as well as economic consequences.
40 448 U.S. 607 (1980).
41 452 U.S. 490 (1981).
42 29 U.S.C. §655(b).

imposed had to await a threshold determination of whether there existed a significant risk of material health impairment.

Though there were hints in the plurality and concurring opinions that cost-benefit analysis was congressionally mandated, and explicit statements in the dissent that reliance on cost-benefit was unauthorized, no final determination of the issue was made until the Cotton Dust Case. There the Court focused on the "feasibility" language of the statute and decided that that requirement displaced the obligation to undertake a cost-benefit analysis of a proposed regulation. Instead, a different, and presumably less rigorous, "feasibility" analysis was required. The function of the latter procedure was to determine that implementation of a proposed standard is "capable of being done."[43]

This semantic exercise, unfortunately, does little to displace the need for some comparative consideration of the costs and benefits of a proposed regulation. Numerous safety standards can be implemented at some cost, and are thus "capable of being done" within the narrow meaning of the Supreme Court's mandate. Less certain is whether the benefits obtained by implementing any standard are worth the associated costs. Unless the congressional directive is to take all precautions that are technologically possible, the absence of some standard by which to determine whether marginal advances in safety are worthwhile is likely to generate either overinvestment or underinvestment in accident avoidance from a societal perspective.

Our point at present, therefore, is to suggest that the obligation to consider values for human life is not only implicated where an agency is required specifically to compare costs and benefits. Statutory provisions may require particular attention to specific regulatory effects rather than a strict analysis that sanctions only those regulations whose benefits exceed costs. The FIFRA provision referred to above, for instance, requires the Administrator to take into account the impact of proposed final action on production and price of agricultural commodities, retail food prices, and the agricultural economy.[44] Similarly, where noncarcinogens are concerned, the Food and Drug Administration is required to determine whether food additives are "safe" for their intended use, a standard that does not necessarily implicate a finding of benefits in excess of costs or require banning additives whose costs exceed marginal benefits.[45]

Indeed, concerns for factors that might escape a naked comparison of costs and benefits have generated statutes that mandate reliance on less quantitative variables. For instance, the Federal Mine Safety and Health Amendments Act,[46] albeit less explicit than its predecessors,[47] demonstrated concern for the safety of miners by requiring closure of mines notwithstanding that the consequent costs might exceed expected losses to miners. Nor do these nonquantitative concerns consistently demonstrate solicitude for safety. Richard Merrill recounts congressional intervention to delay FDA programs designed to reduce the risk of adverse health effects related to shellfish, presumably to satisfy industry concerns.[48] While these programs may require that certain factors on either the cost or benefit side of the calculus be ignored, insofar as they eschew any absolute benchmark by

43 452 U.S. at 509.
44 7 U.S.C. §136d(b).
45 21 U.S.C. §348(c)(3)-(4). See Merrill, supra note 25, at 999.
46 30 U.S.C. §§801-78.
47 See Neely, Statutory Inhibitions to the Application of Principles of Cost/Benefit Analysis in Administrative Decision Making, 23 Duq. L. Rev. 489 (1985).
48 See Merrill, supra note 25, at 1000.

which to determine the propriety of a particular regulation they require some synthesis of costs and benefits. Effective implementation of that mandate, therefore, requires some valuation of human costs saved or lost by the decision to regulate.

Even the emerging judicial antipathy towards cost-benefit analysis does not preclude regulation predicated on some rational basis that includes human life valuations. This is most evident in recent decisions of the District of Columbia Court of Appeals that reflect inconsistent constructions of congressional grants of regulatory authority that affect human welfare.

In Natural Resources Defense Council v. EPA,[49] the District of Columbia Court of Appeals heard an appeal concerning standards for the emission of vinyl chloride promulgated by the Administrator of the EPA. Vinyl chlorides are carcinogens with no known threshold and a twenty-year latency period. Given the uncertainty of the hazards of a particular emissions level, the Administrator had required that emissions be reduced to the lowest level attainable by the best available control technology. The petitioner contended that the statutory basis for regulation, section 112 of the Clean Air Act,[50] precluded consideration of cost or technological feasibility. Instead, the petitioner argued, that provision, which requires emission standards be set at a level that creates "an ample margin of safety to protect the public health, "permitted consideration only of health-related factors. Thus, in the face of uncertainty, the Administrator was constrained to require a zero-emissions level.

In a decision by Judge Bork, a three-judge panel of the court upheld the authority of the Administrator to withdraw proposed regulations of vinyl chlorides by relying solely on economic and technological factors.[51] Congressional delegation of discretionary authority to the Administrator, in Bork's view, permitted the delegate to select the factors that would guide the exercise of that discretion. In a subsequent en banc decision also authored by Judge Bork, however, the court created a standard for "ample margin of safety" that precluded a strict cost-benefit analysis. The court adhered to the view that safety did not require zero-risk and thus dismissed the NRDC position. But it found that the Administrator could not simply define the appropriate margin of safety by reference to what was cost-effective; the Administrator was constrained by the primacy that Congress intended be given to health effects.[52] The court characterized the EPA's position as permitting a standard that would prohibit emissions to a point where marginal costs of additional controls exceeded marginal reductions in risk to health. Thus, definitions of "safety" were not made by reference to the Administrator's expertise, scientific risk assessments, or risks to health at particular emission levels, but only to a naked comparison of "technological and cost feasibility." The court rejected any such approach.[53] While the court was willing to permit consideration of these cost and technological factors, and specifically rejected the view that a "safe" level of emissions was one that was "risk-free," the court did mandate an initial, independent judgment of safety predicated on risks to health at particular emission levels.[54] Determinations of risks to health could be based on both scientific data and non-quantifiable factors such as risks deemed "acceptable in the

49 824 F. 2d 1146 (D.C. Cir. 1987)(en banc).
50 42 U.S.C. §7412(b)(1)(b).
51 804 F.2d 710 (D.C. Cir. 1987).
52 824 F.2d at 1163.
53 824 F.2d at 1164.
54 824 F.2d at 1164.

world in which we live."[55] The "risk to health" decision, however, could not consider cost and technological feasibility. Nevertheless, once the safety threshold had been crossed, the Administrator could address remaining uncertainties by considering those economic factors in determinations of an "ample margin" of safety.[56]

The ability to engage in an explicit cost-benefit analysis became more doubtful under the approach taken most recently by the court in Union of Concerned Scientists v. Nuclear Regulatory Commission.[57] That case concerned the authority of the Nuclear Regulatory Commission to consider economic costs when deciding whether to require safety-enhancing modifications for previously licensed nuclear power plants. The Commission had proposed a rule that would require so-called "backfits" only when their direct and indirect costs were justified by a substantial increase in protection to health and safety.[58] Rather than accept or reject economic costs as the talisman for nuclear regulation, the court attempted a Solomonic compromise: economic costs could not be considered in determining whether regulation was necessary to satisfy the statutory mandate that the Commission provide "adequate protection" to public health and safety.[59] The Commission, however, could consider economic costs, "even to the extent of conducting strict cost-benefit analysis"[60] in establishing safety requirements beyond those necessary to meet the adequate safety requirements. Since the court understood that this interpretation meant that adequate protection was not synonymous with risk-free or absolute protection, the Commission presumably must engage in some sort of analysis of whether costs of regulation are worth incurring in order to render the level of safety "adequate." While the District of Columbia Circuit indicated that strict cost-benefit analysis is not appropriate to the task, and, indeed, has prohibited consideration of costs in the establishment of the adequate protection standard,[61] it seems logically impossible for the Commission to derive a standard of adequacy without paying some attention to the relative costs and benefits of a proposed regulation. To the extent that even"adequate protection" leaves some lives exposed, any meaningful decision concerning the desirability of a proposed regulation must implicitly, if not explicitly, value those lives relative to the cost of the proposal.

These recent cases suggest that application of cost-benefit analysis and the need for valuation of life to test the propriety of a regulatory effort are not coterminous. Even where courts have rejected the propriety of the former, they have not compelled regulations that create a "risk-free" society. The result is the need for regulations that provide "reasonable," "ample," or "adequate" levels of safety. Yet such phrases cannot be defined or applied without some reference to the relative effects of alternative policies. In a situation where human lives are put at risk, any such reference compels agencies to decide whether proposed standards will save sufficient lives to justify the associated expenditure. That justification may be predicated on considerations additional to technological or cost feasibility. But at some point, presumably most individuals in society would cease investing in safety. It is the derivation of that point that ultimately drives the quest for some valuation of life.

55 824 F.2d at 1165.
56 824 F.2d at 1165 ("Once 'safety' is assured, the Administrator should be free to diminish as much of the statistically determined risk as possible by setting the standard at the lowest feasible level.").
57 824 F.2d 108 (D.C. Cir. 1987).
58 10 C.F.R. 50.109(a)(3) (1986).
59 42 U.S.C. §2232(a).
60 824 F.2d at 114.
61 Id. at 119.

III. Issues in the Valuation of Human Life

A. Introduction

As we noted at the outset, our purpose in this report is to examine the processes through which government, implicitly or explicitly, values human life for purposes of regulation. Stating our purpose in this way, however, necessarily accepts the propriety of the effort at valuation and seeks only to refine it. Such a strategy threatens to ignore an important and cogent response to the entire effort at valuation, i.e., that any attempt to quantify the value of human life is inherently inappropriate, not because of the difficulty of the task or the intangibility of various factors that must be considered, but because the very process of quantification ignores and violates the sanctity of human life.

In its broadest formulation, the opposition to quantifying human life is based on the assertion that human life has a "sacred" value that cannot be reflected in monetized or quantified terms.[62] Douglas MacLean, a primary proponent of this view, means by this phrase that we adhere to certain ritualistic beliefs and practices in a manner that expresses the special value of human life in our culture."[63] By so doing, we signal the community that saving lives has merit that exceeds even a precisely computed value. Any attempt to quantify human value is inconsistent with the symbols and rituals that we use to signal life's special meaning within the society.

Alternatively, commentators suggest that the very process of attempting to quantify the value of human life diminishes that value by suggesting that human life is exchangeable in a manner akin to commodities. Regardless of our ability to consider a commodity as a substitute for human life (one can, after all, compare apples and oranges), some suggest that there may be reasons not to admit our lack of uniqueness.[64] We may, for instance, wish to signal to ourselves the intrinsic worth of certain aspects of life in order to indicate that they are not reducible to monetized values. Such arguments have been put forward to explain a desire to invest in clean air beyond an optimal point.[65] We are, in this argument, entitled to "breathing rights" without making any purchase or engaging in conduct that gives rise to a claim of desert. Similarly, we may wish to signal similar entitlements to a "safe" life, a signal that would be subject to substantial static should we admit openly that life can be balanced against other resources. Such an admission necessarily dehumanizes the subject, and reifies the intangibles of life by placing them on a parallel with commodities subject to market transactions.

Finally, there is a concern that the very process of quantification alters the conclusions that one reaches about the value of human life and thus violates the precepts of neutrality that allegedly underlie any concerted effort to address the issue. For instance, some argue that attempts to quantify the value of individual lives necessarily treats individuals separate and apart from the communities in which they live and "reinforces self-

62 MacLean, Social Values and the Distribution of Risk, in D. MacLean, Values at Risk 85-86 (1986) (hereinafter, Social Values); MacLean, Comparing Values (unpublished manuscript).

63 MacLean, Social Values, supra note 62, at 86.

64 See, e.g., Solow, Defending Cost/Benefit Analysis: Replies to Steven Kelman, 5 Regulation 2 (May/June 1981).

65 Tribe, Policy Science: Analysis or Ideology, 2 Phil. & Pub. Aff. 66, 88-89 (1972).

interest as a correct or worthy index of value."[66] By this argument, perhaps understood as a special application of the Heisenberg uncertainty principle in which the measurement process affects outcome, the result would necessarily undervalue life by removing communal values from the process of isolating one individual's worth.

Notwithstanding the cogency of these remarks, we proceed, somewhat unabashed, to analyze efforts to value human life. Our failure to be convinced by the above arguments is based largely on the following responses. First, as a pragmatic matter, it is clear that -- even if we reject the assignment of explicit values -- we as a society constantly engage in the implicit valuation of human life.[67] When we create new technologies that are risk producing, whether they be new machines or drugs to combat disease, we know that the benefits of those technologies carry some degree of cost. Accidents in the production of those technologies, abreactions in consumers, and foreseeable injuries that will result from the negligence of users all reveal that these advances are not risk-free. Nevertheless, we proceed because we believe that even risky technologies may be (net) risk reducing, i.e., they may eliminate a greater quantum of risk than they create.[68] Even if they do not displace greater risks to human life, they may possess other compensating features, e.g., convenience, that offset the risks they pose. Thus, a social decision to proceed in the face of known risks reveals that we (a term that does not necessarily implicate governmental agencies although it has increasingly come to connote them) believe those risks that remain are "worth taking." To the extent that those risks involve threats to human life, we implicitly concur that the value of risks reduced exceeds the value of the lives lost. When we decide to regulate certain activities or not to regulate others, we are implicitly determining that the costs of regulation do or do not exceed the value of lives saved as a result of regulation.

Second, and related to the first, our implicit decisions about human life may be susceptible to some level of quantification. Presumably, we would desire to make the tradeoff between lives and other resources as accurately as possible. If that is the case, failure to attempt any such effort at quantification causes us to generate either too much or too little risk. While one may respond that such a belief ignores the lessons derived from the theory of the second best -- that in the absence of the ability to quantify all variables, it is not necessarily second best to quantify as many as possible -- that theory suggests only that second best solutions may not be preferable to inaction, not that they cannot be preferable.

Third, while there may be something invidious in the quantification process, e.g., in reifying human life or in risking the omission of nonquantifiable variables from the ultimate decision, we do not believe these effects to be inexorable. The effort at determining whether regulations are "worthwhile" in terms of cost per life saved is not necessarily dehumanizing if decision makers are ultimately attentive to both the valuation process and its limits. The desire to consider these factors may help to determine the identity of the ultimate decision maker. For instance, one may consider courts rather than agencies to be more receptive to nonquantifiable variables because courts regulate ex post

66 Swartzman, Sources of Controversy, in Cost-Benefit Analysis and Environmental Regulations: Politics, Ethics, and Methods 72 (1982).

67 See, e.g., E. Stokey & R. Zeckhauser, A Primer for Policy Analysis 149-53 (1978); H. Rosen, Public Finance 193 (1985).

68 See Grady, Why Are People Negligent? Technology, Nondurable Precautions, and the Medical Malpractice Explosion, 82 Nw. U. L. Rev. 293 (1988); Huber, Safety and the Second Best: The Hazards of Public Risk Management in the Courts, 85 Colum. L. Rev. 277 (1985).

and are faced with actual victims, whereas the ex ante approach of regulators necessarily limits them to statistical analysis.[69]

Finally, at the very least, efforts at quantification provide regulators with a common metric and thus permit both regulators and those to whom they are accountable access to some measure of the consistency of regulatory action. If one agency refuses to propose regulations on the theory that they will be too costly at a rate of $X per life saved while another agency promulgates regulations that will cost $2X per life saved, those who analyze the regulatory process have a comparative basis for inquiring into the propriety of regulatory action. Similarly, Paul Rubin has suggested that explicit valuations may enhance regulatory goals of maximizing benefits to consumers for the level of spending that society is willing to invest in safety. Rubin suggests if an agency with a fixed budget can spend $20,000,000 on safety in a given year and can select either a method of safety that saves lives at a cost of $1 million per life or a method that saves lives at a cost of $2 million per life, explicit recognition of these values will increase total lives saved (by concentrating its resources into the first method) over random selection of the alternatives (e.g., by investing $10 million in the first method and $10 million in the second).[70] Implicit in this objective is the understanding that once part of our social budget is allocated to safety, it ought to be spent in a manner that maximizes the number of lives saved. This understanding is not necessarily tautological. There may be intuitions that lead us to favor spending in a manner inconsistent with maximum life saving.[71] Nevertheless, we might test the strength of these intuitions by determining how far they deviate from a principle of maximum life saving. In any event, the principle of maximum life saving poses substantial difficulty for the thought that life valuations are inconsistent with respect for the symbolic or sacred value of life. It would be somewhat anomalous to hold life sacred without simultaneously attempting to maximize the number of lives saved. Thus, even the sacredness approach may require some attention to the relative implicit values of regulation for health and safety.[72]

Our review of federal agency practices reflects these concerns. Not all agencies accept the view that valuation of human life is an appropriate governmental enterprise. The most forthright rejection can be found at the National Highway Traffic Safety Administration ("NHTSA"), despite its location within a department, the Department of Transportation, whose regulatory procedures call for quantitative benefits analysis (DOT's "Guidance for Regulatory Evaluations"). NHTSA strongly objects to full benefits analysis of fatality avoidance: "It should be noted that this Agency does not consider it appropriate to place a dollar value on human life or injuries."[73] NHTSA believes that it is useful to quantify the clearly monetizable consequences of accidents, particularly property damage, lost productivity, and medical and legal costs. It acknowledges that these constitute only a subset of all benefits from accident reduction, but it chooses not to value other benefits explicitly. It merely states the number of lives or injuries at risk.

[69] See Gillette & Krier, Risk, Courts, and Agencies (unpublished manuscript 1988). See also text accompanying notes 125-34 infra.

[70] See Memorandum from Paul Rubin to Consumer Product Safety Commission, Feb. 25, 1986.

[71] See Fried, The Value of Life, 82 Harv. L. Rev. 1415, 1418 (1969).

[72] Id. at 1425.

[73] NHTSA, The Economic Cost to Society of Motor Vehicle Accidents 1-2, DOT HS 806342, January 1983.

Other agencies appear to use explicit values sporadically. For instance, memoranda from the Consumer Product Safety Commission reveal use of a $1-2 million valuation of life in discussions concerning regulation of disposable cigarette lighters and bunk beds.[74] Other memoranda reveal no explicit valuation of life, but only elaboration of the per life costs that would have to be incurred in a regulatory effort. For instance, discussions concerning a particular regulation assume a variety of accident avoidance measures with varying costs. On the assumptions stated in the discussion, these cost estimates range from $2.6 million to $312.5 million per life saved. While the discussion does not incorporate any assignment of value for life, one would infer that proceeding with the more expensive regulatory effort reflects a judgment that life is worth that much, while failure to utilize a more expensive alternative that would save more lives reflects a judgment that the expenditure is not justified, i.e., that saving the marginal lives is simply not worth the necessary added expenditure.

None of the above suggests that valuation is a task devoid of computational, ethical, or legal difficulties. Indeed, extraordinary difficulties in any of the above may render the results of any computation so suspect as to undermine the propriety of the effort. In the remainder of this report, we will investigate the extent of those difficulties. At this point we only conclude that those inquiries should not be precluded by any threshold aversion to quantification.

Nevertheless, there may be situations in which monetization of human life has little merit, given the computational and ethical difficulties associated with the project. For instance, where other factors of uncertainty are so dominant as to dwarf potential disagreements about values for life, paying much attention to the latter factor seems unproductive. Assume, for instance, that a particular regulation is anticipated to lessen a risk, but available scientific evidence is too weak to permit reliable quantification of the risk reduction, e.g., the evidence permits only a range of probable reduction at somewhere between 1:10,000 and 1:1,000,000. In this situation, application of a precise figure for human life to diffuse estimates of risk reduction will do little to resolve the question of the proposed regulation's cost-effectiveness. Thus, little is to be gained by evaluating the value of lives saved in this context alone. Short of such situations, however, we believe that the valuation process theoretically generates a more informed and effective decision basis for risk-reducing regulations.

B. Problems of Quantification.

If we knew with certainty the costs of regulation and the number of lives that could be saved by implementing any given proposal, quantifying the value of individual human lives would be unnecessary to achieve the most cost-effective level of regulation. Instead, we could determine an appropriate "life-saving budget" and adopt regulations seriatim, starting with the one that saved the most lives per dollar, until the funds allocated to life-saving were exhausted. Unfortunately, this felicitous scenario is unlikely to materialize as long as implementation costs are uncertain and are calculated differently across agencies. Indeed, even if we could impose some uniform calculus on agencies, we might fear that its wooden application would fail to recognize that we do not treat all deaths equally. Avoidance of cancer deaths might warrant expenditure of more resources than avoidance of an equal number of deaths in automobile accidents, simply because we dread the painful and extended deterioration that accompanies the former. Thus, some mechanism that

[74] See Memo from Dale Ray to Paul Rubin, May 5, 1987 (cigarette lighters); Memo from Dale Ray to David Thome, September 23, 1987 (bunk beds).

reflects our treatment of different deaths should augment initial rankings of the "most effective" regulations.

On its face, a procedure that values both the costs and benefits of regulation would appear appropriate. Any such procedure ideally would quantify all the consequences of implementing a particular level of life saving. Thus, it would permit a differentiated view of the effects of regulations not possible if all deaths are treated equally. Applying such a mode of analysis to the area of health and safety regulation, however, creates an additional set of difficulties. Cost-benefit analysis poses relatively little difficulty where components of the calculus constitute commodities that are exchanged at competitively negotiated prices in established markets or that are otherwise susceptible to socially acceptable quantification.[75] Thus, a decision by a rational, self-interested, profit-maximizing entity to invest in a device that will cost $X and will replace current production modes that cost $X+1 seems relatively straightforward. The difficulty that pervades cost-benefit analysis involving human life is the absence of any reliable "market price" that can be used as a standard for fair exchange. In the absence of a market, some alternative means must be found for establishing what we are willing to invest in order to save a human life. Human life has value not simply because of the ability of humans to produce goods that do have market values (a function that does permit some measure of the value of human life, often termed human capital[76]) but also because life generates additional values less susceptible to quantification. Within this category lie such factors as "community," "friendship," and the "hedonic" value of life.

In this section we consider the primary approaches that federal agencies have adopted to address this difficult issue of quantification. We trace the history of their use and the relevant methodology. Finally, we consider some of the critiques of each approach and attempt to reach some conclusions about whether those critiques are so substantial as to undermine any utility that the quantification effort might otherwise possess.

1. Initial Efforts; Human Capital Reasoning.

However one might choose to characterize its overall impact, loss of life does have the quite tangible consequence of lessened production and consumption of goods and services. This fact forms the basis for one longstanding approach to the valuation of life, which is often referred to as the human capital approach. Premature destruction of a productive machine would deprive society of whatever output it was capable of yielding over its remaining years of usefulness. The human capital approach relies on an analogy between such productive physical capital and the economic productivity of people. Thus, this approach equates the value of life with the dollar value of goods that can be produced by the person whose life is at risk. In particular, one can estimate the amount of future income that will be forgone if a person's productive effort comes to an early end due to death. This provides one measure of the value of a life.

The human capital concept is quite useful for a number of policy questions. For example, consider the issue of setting priorities for types of capital spending to stimulate economic growth. Not recognizing that human productivity can be increased by outlays on training could lead to an overemphasis on acquiring physical capital. Similarly, if one were concerned with the issue of optimal investment in life insurance to assure a suitable income

75 See Baram, supra note 15 at 483; Zeckhauser, Measuring Risks and Benefits of Food Safety Decisions, 38 Vand. L. Rev. 539, 544 (1985).
76 See discussion at text accompanying notes 77-95 infra.

stream in the event of one's death, a human capital approach would be appropriate.[77] Moreover, the concept has practical appeal -- say in debating the merit of further education -- both at the level of the identifiable individual and for large group decisions.

But in the context of fatality-risk reduction, human capital thinking can at best provide incomplete answers, as it considers only losses in national income and fails to consider other losses, including the at-risk individual's own desire to live.[78] Cutting short a human life has a significance that includes but transcends measurable output effects. Mishan reviews some of the early efforts to base life valuation on expected future earnings and identifies conceptual weaknesses.[79] For example, Mishan notes the commonly articulated but rarely satisfied need to buttress estimates of forgone earnings with values for consequences such as pain and suffering and family bereavement. As appealing as this might seem, it moves the analyst well beyond readily available and verifiable data sources. Other than jury verdicts relating to pain and suffering, there exists little basis to assess the amount of money that would compensate for suffering and bereavement.

On the other hand, restricting our measure to forgone earnings, while assuredly facilitating objective estimations, carries with it certain ethically troublesome implications. Any approach based on lost earnings will place low valuations on the lives of those who are neither wage earners nor producers of goods or services in developed markets, for example, retirees and homemakers (although markets have developed for some homemaking functions, e.g., child care and cooking). This can lead to any number of objectionable policy outcomes. Suppose two alternative strategies for hazard reduction would avert the same number of total deaths, but one would disproportionately benefit retirees (which could happen if the region benefiting most from one strategy had an older population). An application of a human capital approach to benefits valuation would make the latter strategy look less warranted. Yet few would find this an acceptable basis on which to make a choice between the two alternatives.[80]

Whether as a matter of social policy we would prefer the alternative that protects a more youthful subgroup may be an unavoidable decision. But using a monetization process that neglects everything but future individual productivity would not clarify or inform the decision; it would merely mask its real implications with the appearance of quantitative objectivity. The underinclusiveness of the human capital approach would be exacerbated if it systematically excluded or undervalued particular components of a "valuable" life. The approach appears to suffer from just such a defect insofar as it provides no mechanism (such as shadow prices) for losses that are unrelated to production or market forces and that are, therefore, difficult to quantify. Examples include pain and suffering, psychic harms, and dread of catastrophic or involuntary risks.

Additionally, human capital approaches may incorporate invidious social effects that reflect lower productive values for persons kept from highly productive jobs for reasons

77 See L. Dublin & A. Lotka, The Money Value of a Man (1930); M. Jones-Lee, The Value of Life: An Economic Analysis 21-22 (1976); Linnerooth, The Value of Human Life: A Review of the Models, 17 Econ. Inquiry 52, n.1 (1979).
78 Id. at 53.
79 E. Mishan, Cost-Benefit Analysis 320-45 (3d ed. 1982).
80 This is not to suggest that alternative methodologies are free of such skews. For instance, in a willingness-to-pay approach, discussed infra, it might be that younger people would be willing to pay more than older people to avoid risks of fatality. Cf. Arthur, The Economics of Risks to Life, 71 Am. Econ. Rev. 54 (1981).

having little to do with ability to perform those jobs. For instance, assume that a segment of the population is the subject of employment discrimination. Thus, members of this segment either cannot obtain certain jobs or can obtain them only by accepting a wage less than that of similar workers outside the discriminated group. Assume further that this group is found to be particularly susceptible to a certain disease or injury (e.g., sickle-cell anemia for blacks, Tay-Sachs disease for Jews, breast cancer for women). Finally, assume that these risks could be avoided at a cost of $X. If $X is weighted against the human capital costs of the at-risk group, without taking into account the effects of invidious discrimination on the productive capacity of the group, then the cost effectiveness of the curative will be grossly understated.[81] One variant of the human capital approach common in highway policy circles until 1984 employed an even more offensive assumption that the value attached to a life (reflecting future wages) should be lessened by that individual's future consumption.[82] Then having in the analyzed group some elderly people who consume but do not work would have the bizarre effect of actually valuing certain deaths positively.

Notwithstanding these critiques, human capital approaches provide the benefit of administrative ease.[83] Actuarial tables provide justifiable estimates of life expectancy and projected earnings for those placed at risk. In addition, the ethical concerns have not been so strong as to preclude the widespread use of human capital approaches in a variety of situations. Perhaps most commonly, expected earnings remains the primary component of compensation in wrongful death actions in the judicial system.

In summary, the human capital approach appears most objectionable for its exclusion of factors relevant to value that are not easily translated into terms of productive capacity. Advocates of cost-benefit analysis are not oblivious to these concerns about variables that resist quantification. The response, however, seems largely to take two forms. One is urging those who employ cost-benefit analysis to be sensitive to additional variables not considered in the quantification process. The other is to separate formally the process of quantification from decision making, or risk assessment from risk management.[84]

Unfortunately, neglect at quantification stages of what Lawrence Tribe early described as "soft variables" may preclude their subsequent reintroduction into the policy

81 See Acton, Measuring the Monetary Value of Lifesaving Programs, 40 L. & C. Prob. Pub. Health 1954, 1960 (1967).
82 Miller, Accident Costs and Safety Policy Decisions, unpublished paper, January 12, 1986 at 2.
83 See Acton, supra note 81; at 52; Arthur, supra note 80, at 54; Cook, The Value of Human Life in the Demand for Safety: Comment, 68 Am. Econ. Rev. 710 (1978).
84 See Ruckelshaus, Risk in a Free Society. On this view, risk assessment is a neutral process, informed solely by pure and objective scientific investigation and measurement. Risk managers, on the other hand, filter the objective data provided by risk assessment through their political roles to determine the proper social policy. Commentators have recognized the difficulty of separating these functions. Uncertainties inherent in the scientific investigation, degrees of confidence in results, and ranges of probability that risks will materialize all raise risk assessment issues that can only be resolved through incorporating the values of the investigator. See Latin, Good Science, Bad Regulation, and Toxic Risk Assessment, 5 Yale J. Reg. 89 (1988).

decision.[85] Decision makers who would ideally reconcile quantifiable data and more ephemeral considerations may be driven by the "hardness" of the former and the abstraction of the latter to rely solely on the data. Quantifiable variables give the decision maker something concrete to point to in order to justify a particular decision and create an impression of scientific impartiality and certainty. Simultaneously, reliance on quantifiable variables, such as expected earnings over a given number of years in a particular occupation, avoids the need to consider other values that compete with economic utility. Thus, Thomas Nagel writes that attempts to resolve conflicts by reference to a single general system, e.g., a quantitative one, bars as "irrelevant or empty all considerations that cannot be brought within the scope of that system."[86]

Indeed, to some extent, legal doctrine invites regulators to ignore certain "soft variables," notwithstanding the very real costs that they involve. For instance, the Supreme Court has determined that the National Environmental Policy Act of 1969[87] did not require the Nuclear Regulatory Commission to evaluate psychological effects on nearby residents prior to approving operation of the Three Mile Island nuclear power plant after a major incident at that facility.[88] Although the Court recognized the existence of such effects, it determined that the statute addressed solely effects of conduct on the physical environment rather than to perceptions of risk.[89]

There is some evidence that soft variables or those external to the general system do not get completely ignored. Social or political values may cause regulators to resist decisions that appear mandated by reference to quantified values alone. Some commentators have explained this phenomenon by reference to the existence of "trumps" in the risk management process.[90] But given the politics of regulation, intervention of trumps would seem fortuitous rather than systematic. Their introduction may depend on whether the affected population has sufficient political power to persuade legislators or regulators of the need for or inappropriateness of regulation. Political capacity may turn on such issues as discreteness of injury and diffusion of the affected population rather than on any merit-based criterion. Thus we are left with a general concern that quantifiable variables take on a life of their own and override other, less quantifiable concerns. Leonard and Zeckhauser similarly suggest that these effects are inevitable.[91] They take comfort, however, in the fact that the skews are not unidirectional. They state:

> But this limitation is itself ethically neutral unless it can be shown that the quantifiable considerations systematically push decisions in a particular direction. In other words, it is not sufficient to argue that cost-benefit analysis does not handle perfectly what is obviously a very hard task; rather, its detractors must show that its errors are systematically unjust or inefficient -- for example, that it frequently helps the rich at the expense of

85 Tribe, supra note 65. See also Michelman, Norms and Normativity in the Economic Theory of Law, 62 Minn. L. Rev. 1015 (1978).
86 Nagel, Fragmentation of Value 137, in T. Nagel, Mortal Questions (1979).
87 42 U.S.C. § 4321.
88 Metropolitan Edison Co. v. People Against Nuclear Energy, 460 U.S. 766 (1983).
89 The Court did suggest that risk perception raises an issue of whether a particular technology should be utilized. 460 U.S. at 776. The Court held, however, that any such issue was not implicated in the statutory issue before it.
90 Leonard & Zeckhauser, Cost-Benefit Analysis Applied to Risks: Its Philosophy and Legitimacy 31-42, in D. MacLean, Values at Risk (1986).
91 Id. at 44-45.

the poor, or that the environment is systematically disadvantaged to the benefit of industry. We have not seen any carefully researched evidence to support such assertions.[92]

Three problems exist with this reasoning. First, those errors that exist do not necessarily cancel each other out. If two decisions are made, one of which adversely affects the rich and the other of which adversely affects the poor, there is no reason to believe that the same parties will be affected or that the inefficient or unfair effects of each decision will precisely (or remotely) offset the other. Second, it is unclear why the burden of proof is on the dissenters. Why not place it on those who desire to use cost-benefit rather than on those who oppose it? Given uncertainty about the validity of an analytical tool, placement of the burden of proof may be determinative of outcome. While there may well be substantial ethical and pragmatic justifications for using some form of cost-benefit analysis, it is unclear why they need not be explicitly proffered by those who would employ such methods. Third, the discussion implies that the process of risk assessment is readily separable from that of risk management. On this view, risk assessors are apolitical technocrats who generate quantitative data based on value-neutral processes and deliver it in pristine fashion to political decision makers.[93] These risk managers then filter the information through a political process that responds to political trumps. Unfortunately, this ideal remains distant from the actual process of risk assessment. As we shall discuss later in this report, political and scientific values are inherent in the decisions of risk assessors to employ certain test procedures, to present data in certain forms, and to select or ignore certain hypotheses. Thus, what risk managers receive, and what they can therefore subject to political trumps, has already been filtered through a rigorous value system.

2. Toward Willingness-to-Pay Approaches.

The inherent limitations on the utility of human capital approaches have led policy makers to seek more acceptable alternatives to the valuation of life. Following a 1968 article by Thomas Schelling,[94] researchers have seized on a theory of valuing life by determining what individuals would be willing to pay in order to reduce the probability of death or what they would accept to have that probability increased.[95] This method, known as the willingness-to-pay approach, assumes that one can get a sense of how people will value a small reduction in the risk of accidental death by examining their behavior in the marketplace. To the extent that it is successful, the willingness-to-pay approach avoids many of the obstacles associated with human capital valuations. For instance, willingness-to-pay assumes that people internalize the "soft variables" excluded from the human capital approach and that they express a monetized value for those factors, e.g., concern for pain, dread of particular types of death, in their marketplace choices for goods, services, and occupation. Additionally, willingness-to-pay provides the normative appeal of consistency

92 Id. at 44.
93 See Rowe, Government Regulation of Societal Risks, 45 G.W.L. Rev. 944 (1977).
94 Schelling, The Life You Save May Be Your Own, reprinted in T. Schelling, Choice and Consequence 113 (1984).
95 Conley, The Value of Human Life in the Demand for Safety, 66 Am. Econ. Rev. 45 (1976); Dardis, The Value of Life: New Evidence from the Marketplace, 70 Am. Econ. Rev. 1077 (1980).

with individuals' preferences.[96] People may incorporate into their responses to willingness-to-pay inquiries factors such as the nature of the risk they confront (e.g., voluntary vs. involuntary) and the type of death (prolonged agony or quick and painless) they will suffer should a risk materialize.[97]

Operation of the willingness-to-pay approach is illustrated in EPA's 1983 review of the literature. If, for instance, an individual voluntarily takes precautionary steps that cost $10 and reduce the probability of death in a particular situation from 10 in a million to 5 in a million, then the implied value of life can be computed as $10/.000005 = $2 million.[98] The data most commonly relied on for these purposes are drawn from labor market studies of the wage premium observed in comparisons of jobs varying in their fatality risks (using multivariate regression analysis to isolate the influence of risk). However, other data sources also have been tapped. For example, some studies have drawn inferences from consumer choices ranging from seat belt usage to willingness to take risks through speeding or not using crosswalks (sometimes called hedonic approaches to willingness to pay) and from consumer behavior in the selection of relatively risky products.[99] Others have relied on surveys of consumer attitudes toward actions that lessen risk (sometimes referred to as contingent valuation approaches to willingness-to-pay).[100]

Numerous willingness-to-pay studies have been completed. Viscusi concludes that for typical risk situations, a range of about $2-3 million can be defended, as can higher values for involuntary risk situations. Miller finds credible values of $1.4 million plus or minus 40%.[101] The Environmental Protection Agency's own conclusions about value of life are more guarded, suggesting a range of $400,000 to $7 million in 1982 dollars.[102] Elsewhere, however, EPA staff have suggested $1.5 to $2 million as a reasonable norm,[103] and an EPA staff draft recently identified $1.6 million to $8.5 million as supportable.[104]

Bottom Line

3. The Limits of Willingness-to-Pay.

Economic reasoning suggests that willingness-to-pay is theoretically superior to the human capital approach to valuing human life. A person's willingness to pay to avoid a

96 For a formal exposition of the assumed decision process involved in deciding the value of reducing risk of death, see Jones-Lee, The Value of Changes in the Probability of Death or Injury, 82 J. Pol. Econ. 835 (1974).
97 See Acton, supra note 81, at 50-51.
98 EPA, supra note 7, at 1-2.
99 For a survey of different studies, see EPA, supra note 7.
100 For an analysis of the credibility of questionnaires and surveys, see Jones-Lee, Hammerton, & Philips, The Value of Safety: Results of a National Sample Survey, 95 Econ. J. 49, 66-71 (1985). The authors report mixed results concerning the veracity and rationality of responses, but find that results from questionnaires concerning the value of life parallel results obtained through revealed preference studies, i.e., about £1.25 million in 1981 prices. See id. at 71.
101 Miller, supra note 82, at 15.
102 EPA, supra note 7, at 6-3.
103 Luken, National Research Council at 13.
104 See note 11 supra.

risk presumably incorporates that individual's valuation of factors that are difficult to measure independently, and thus this approach necessarily considers nonquantifiable variables that cost-benefit analysis is typically accused of ignoring. For instance, consider an individual who could purchase either of two gasoline lawn mowers that are identical in all respects other than that one of them contained a one-gallon tank of gas and the other contained a two-gallon tank. If a consumer were willing to pay $10 more for the latter, we could infer that the convenience of less frequent fillups was worth $10 to that consumer. Thus, we could quantify a soft variable, convenience, that is easily overlooked and for which there is no market for exchange from which to derive an explicit value. Similarly, willingness-to-pay may reveal values for aspects of safety not otherwise readily quantifiable.

This advantage of the willingness-to-pay approach, however, should not be understood as a panacea for the problem of the immeasurable. The limitations of willingness-to-pay fall into several general categories. The first is mobility. Information extracted from labor studies must assume jobs and wage rates that are accepted volitionally, without exogenous constraints. In fact, however, jobs and wage rates may be accepted under conditions in which alternatives are restricted by mobility or cultural considerations that limit the horizons of workers.

The second problem is informational. Willingness-to-pay serves as a useful measure of value only where the expressed preferences are based on knowledge that accurately reflects both the payer's probability of death and the losses that will occur should that risk materialize. The need for such information suggests that willingness-to-pay approaches may be of limited utility where actors are ignorant of or systematically miscalculate the relevant variables. Because this information may be difficult to obtain, investment in search may be rational only where decisions that incorporate the information occur with some regularity. In short, repeat players may be willing to obtain the relevant information, while single- or infrequent-play players may not. For instance, individuals may want to seek out risk information in decisions to engage in particular occupations, since those risks will be confronted continuously during the course of employment. Thus, Viscusi and O'Connor report that chemical workers perceive occupational risks that do not deviate significantly from objective measures.[105] A consumer considering which hedge trimmer to purchase, however, may avoid inquiries into relative risk among models as the search for that information will seem too costly given the infrequent use the consumer expects to make of the product. Indeed, there exists some evidence that regulation may (perversely) *enhance* tendencies to ignore risks. Viscusi notes a lack of "clearcut evidence of a significant beneficial effect on product safety" from Consumer Product Safety Commission regulations, some of which were intended to convey information to consumers. Indeed, accidental poisonings, Viscusi finds, did not decrease after the advent of safety caps, perhaps because of a "lulling effect" that regulation had on risk perception.[106]

Even if they are more likely to consider risks, repeat players such as employees may be subject to other biases that cause them to misapprehend the level of risk to which they are exposed and thus to misstate what they would be willing to pay or accept to reduce that risk. The literature of cognitive dissonance suggests that those who find themselves in risky situations without an easy way of escape are prone to deny the existence of the risk.

105 Viscusi & O'Connor, Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?, 74 Am. Econ. Rev. 942 (1984).
106 Viscusi, Consumer Behavior and the Safety Effects of Product Safety Regulation, 28 J. L. & Econ. 527 (1985).

Any alternate view would require the actor to recognize that he or she has made a choice that is inconsistent with the actor's preference for thinking well of himself or herself, e.g., that the actor made a decision about employment that is personally safe.[107] Note that this phenomenon is likely where actors discover risks of choices previously made; known risks of future projects can be factored into the the decision whether to undertake the project. Nevertheless, where workers become aware of risks that attend the jobs they have held, or become aware of risk-reducing technology that they could employ at their jobs, they may fail to adjust their behavior to take into account the risks or the new technology.[108] Similarly, they are likely to understate their willingness to pay to avoid those risks, as such payments would implicitly recognize the hazards of their occupation. Thus, willingness-to-pay evidence obtained from such individuals cannot be equated with rational decisions about the value one places on one's life.

The third problem of willingness-to-pay is the presence of externalities. Even an accurately computed willingness-to-pay amount predicated on all available information will reflect only those losses that the payer seeks to avoid. Thus, externally imposed losses, e.g., losses suffered by those other than the payer and his or her immediate family, may not be reflected in the calculation at all. Assume, for instance, that an individual is willing to take a slightly more risky job, but only if it pays a somewhat higher wage. The wage differential will reflect the value to the worker of the change in risk of death. If the worker were to fall victim to an accident of the type that made the job risky, however, all the consequent losses might not be internalized by the worker. While the potential loss shared by close relatives and friends might be reflected in the worker's decision, and the loss felt by the employer might be reflected in market transactions with consumers of the goods produced by the employer, the loss felt by others -- co-workers, more distant relatives and acquaintances -- would not be reflected in the worker's calculations at all. Nevertheless, these individuals could feel real and substantial losses. Thus, the willingness-to-pay approach, while generally rendering a higher value for life than the human capital approach, will systematically undervalue life.[109] On an alternative view, however, externalities will lead to systematic overvaluation. Individuals will not, in valuing their own lives, consider the benefits conferred on others in the form of increased opportunities for consumption as a result of the death of a would-be consumer.[110] This view, however, fails to balance

107 See Akerlof & Dickens, The Economic Consequences of Cognitive Dissonance, 72 Am. Econ. Rev. 307, 308 (1982).
108 Id. at 316.
109 We are not here concerned with a second type of external effect, i.e,. the failure of wage rates to reflect risks of death that workers may impose on others. For instance, the Environmental Protection Agency's analysis of vinyl chloride, discussed above, was based on additional cancers that would be suffered by residents living near plants rather than by workers. It is unlikely that even fully informed employees not at risk would demand wages that reflected risks imposed on non-workers. To the extent that those at risk are not consumers of the risky product, consumer prices are similarly unlikely to reflect amounts that those at risk would be willing to pay to avoid a hazard. Nevertheless, those at risk would presumably be willing to pay something to reduce their risk, if only there were a market in which they could effect the transaction. In a recent article, Viscusi, Magat, & Forrest, Altruistic and Private Valuations of Risk Reduction, 7 J. Pol. Anal. & Management 227 (1988), the authors relate evidence that individuals are willing to act altruistically to reduce risks to others. The level of altruism, however, is limited and dissipates with the geographical distance between the actor and the beneficiary.
110 See Arthur, supra note 82, at 62.

increased consumption against decreased production which may also follow from the death of one of society's members.

Some risks present both the externalities problem and the informational problem. For instance, the Nuclear Regulatory Commission must determine whether proposed measures are necessary to ensure "adequate protection" of human health from the risks created by nuclear power plants.[111] A willingness-to-pay basis for measuring the cost effectiveness of a proposed improvement would confront two difficulties. First, those affected by a nuclear accident will not necessarily be limited to "expert" workers or others to have information about the risk they face. Thus the low probability of such an accident is likely to distort the relationship between expressed willingness-to-pay and the actual risk. Second, any such accident will likely generate substantial external effects that will not be included in willingness-to-pay evidence. The person placed at risk will not necessarily discriminate between the consequences of death in a nuclear holocaust and death in an automobile accident. Either case poses similar consequences for friends, relatives, and others who depend on the victim. The former risk, however, constitutes a catastrophe that threatens additional injuries through the loss of community, monumental stresses on medical and social facilities, and the possibility of substantial economic dislocations in the larger society.[112] While some have suggested that catastrophe poses no greater costs than the aggregate of an equivalent number of individual losses,[113] there is evidence that total losses are greater in the former case.[114]

Infrequency of exposure suggests the fourth problem of the willingness-to-pay approach: cognitive limits on the information utilized in the underlying calculus. For the most part, the risk of death related to products or to occupations is quite small. Infrequency does not affect either the desirability of considering the risk or the technical ability to calculate its value.[115] Even with small risks, expected losses can be derived by multiplying the probability times the loss that will occur should the risk materialize. Expected utility theory suggests that rational decision making would be guided by these precepts.[116] Developments in cognitive theory, however, suggest that individuals seriously deviate from results dictated by expected utility theory where probabilities are small.[117] These errors may at times generate underassessment of a risky event's

111 42 U.S.C. §2232(a).

112 See Spangler, A Critique of Methods in the Quantification of Risks, Costs and Benefits in the Societal Choice of Energy Options 119, 125, in 10 Annals of Nuclear Energy (1983).

113 See Nichols & Zeckhauser, The Perils of Prudence, Regulation, Nov./Dec. 1986 at 23.

114 See, e.g., K. Erikson, Everything in its Path: Destruction of Community in the Buffalo Creek Flood (1976); Rabin, Dealing with Disasters: Some Thoughts on the Adequacy of the Legal System, 30 Stan. L. Rev. 281 (1978); Rosenberg, Class Actions for Mass Torts: Doing Individual Justice by Collective Means, 62 Ind. L. J. 561, 576-77 (1987).

115 On the error of ignoring remote probabilities, see D. Parfit, Reasons and Persons 73-75 (1986); Shrader-Frechette, Parfit and Mistakes in Moral Mathematics, 98 Ethics 50, 54 (1987).

116 See K. Arrow, Essays in the Theory of Risk-Bearing 52-68 (1974).

117 See, e.g., Ayres & Sandilya, Catastrophe Avoidance and Risk Aversion: Implications of Formal Utility Maximization, 20 Theory and Decision 63 (1986); Dardis, supra note 95, at 1081 (realizing limits to model that would require individuals to distinguish between

occurrence and at times may generate overassessment. If the risk is not salient to the actor, as may be the case where injuries materialize only after significant latency periods, then actors are unlikely fully to consider the risk in determining what wage to demand in return for the exposure. This may particularly be a problem where risks are infinitesimal, notwithstanding that they create substantial losses should they, in fact, materialize.

If, on the other hand, the actor can readily call to mind examples of a risk's materialization, the actor is likely to demand compensation in excess of the expected loss of the risk. In this latter situation, known in cognitive theory as the "availability" heuristic,[118] the actor may designate recent or easily recalled events as common, notwithstanding that their appearance does not affect their statistical infrequency. Whether risks are recalled with too much or too little frequency, it can be anticipated that the expressed willingness of individuals to pay to avoid the risk will fail to reflect the actual probability of the risk and will thus deviate from what those same individuals would have been willing to pay had they been cognizant of more accurate probabilities. Here again, there is some evidence that those with frequent exposure to risks or information about risks ("experts") may more accurately predict the probability that a remote risk will materialize. Thus, willingness-to-pay evidence may be more credible when derived from experts than from those whose data base is suspect.[119]

Some of the biases inherent in evaluating infrequent risk may be avoided by questionnaires that make the risks salient to the respondent.[120] This possibility, however, creates an additional danger of the willingness-to-pay approach -- one related to the manner in which risks are presented to respondents. Individual preferences for particular actions may depend on the context in which a decision arises or the manner in which a particular decision is framed. The acceptability of social policies may even vary depending on whether the results are classified in terms of lives lost or lives saved, notwithstanding that the social consequences are identical in each case.[121] Additional biases may be apparent if

probability reductions of 2×10^{-6} and 4×10^{-6}); Kahneman & Tversky, Prospect Theory: An Analysis of Decision Under Risk, 47 Econometrica 263 (1979). But see Brookshire, Thayer, Tschirart & Schulze, A Test of the Expected Utility Model: Evidence from Earthquake Risks, 93 J. Pol. Econ. 369 (1985) (property values in California reflect reaction to low-probability risks consistent with expected utility model).

118 Tversky & Kahneman, Judgment Under Uncertainty: Heuristics and Biases, 185 Science 1124, 1127 (1974); Taylor, The Availability Bias in Social Perception and Interaction 190, in D. Kahneman, P. Slovic & A. Tversky, Judgment Under Uncertainty: Heuristics and Biases (1982). For applications to legal theory, see Gillette, Commercial Rationality and the Duty to Adjust Long-Term Contracts, 69 Minn. L. Rev. 521 (1985); Robinson, Rethinking the Allocation of Medical Malpractice Risks Between Patients and Providers, 49 L. & C. Prob. 173 (Spring 1986); Schwartz & Wilde, Imperfect Information in Markets for Contract Terms: The Examples of Warranties and Security Interests, 69 Va. L. Rev. 1387 (1983).

119 See Slovic, Fischhoff, & Lichtenstein, Facts & Fears: Understanding Perceived Risk 182, 191-92, in R. Schwing & W. Albers, Societal Risk Assessment: How Safe is Safe Enough? (1980).

120 See, e.g., Acton, supra note 81, at 62-64.

121 Tversky & Kahneman, The Framing of Decisions and the Psychology of Choice, 211 Science 453 (1981). In this work, the authors relate an experiment in the consequences of framing in which a group of students were asked to choose between two alternative programs to combat an expected outbreak of a disease from which 600 people would die unless one alternative program was adopted. The first alternative was stated as one that

we relax the assumption, implicit in the analysis to this point, that methods of valuation that seek to assess what an individual would be willing to pay to decrease a risk of death (e.g., consumer product studies) are functionally equivalent to methods that seek to discern what an individual would demand in order to take an increased risk of death (e.g., labor market studies for risky jobs). Contrary to this assumption, some research suggests that individuals may value resources differently depending on whether they are paying to obtain an entitlement (receive a gain) or demanding compensation for the surrender of an existing entitlement (avoid a loss). If the entitlement had a constant value, an individual would demand as compensation an amount equivalent to what the individual would be willing to pay to maintain the resource. But there is evidence that individuals have asymetric attitudes towards gains (or maintaining the status quo) and losses.[122] Thus, an abutter of a pristine lake might demand more of a potential polluter than the same person would personally spend to maintain a clean lake.[123]

The implications of deviations between "offer" (purchase) prices and "asking" (compensation) prices for valuation procedures are theoretically quite substantial. Since asking prices generally exceed offer prices, labor market studies that measure wage premiums for exposing oneself to additional risk would be expected to state values higher than those derived from studies of what consumers would pay for safer products or more adequate warnings. In fact, however, studies of consumers and workers differ in methodology sufficiently to call into question whether mortality risks are being valued differently because of the perspective of the evaluator or the appraisal method utilized. Thus, even the same investigator may apply different investigative techniques that explain variations in results.[124]

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would save 200 people while the second alternative was stated as one that caused a 1/3 probability of saving 600 people and a 2/3 probability of saving no one. Seventy two percent of the group chose the first alternative. Another group was presented with the same threat and the following alternatives: one that would cause 400 deaths and one that created a 1/3 probability that nobody would die and a 2/3 probability that 600 people would die. Seventy-eight percent of this group selected the second alternative. See Tversky & Kahneman, Rational Choice and the Framing of Decisions, 59 J. Bus. S231 (1986). But see Fagley & Miller, The Effects of Decision Framing on Choice of Risky vs. Certain Options, 39 Org. Behav. & Human Decision Processes 264 (1987) (concluding that effect of framing may be less robust than previously reported).

122 Empirical data to support the disparity is offered in Knetsch and Sinden, Willingness-to-Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures Value, 99 Q. J. Econ. 507 (1984). See Kelman, Consumption Theory, Production Theory, and Ideology in the Coase Theorem, 52 S. Cal. L. Rev. 669 (1979); Hoffman & Spitzer, A Reply to Consumption Theory, Production Theory, and Ideology in the Coase Theorem, 53 S. Cal. L. Rev. 1187 (1980).

123 See A. Polinsky, An Introduction to Law and Economics 123-26 (1983); Note, An Economic Analysis of Tort Damages for Wrongful Death, 60 N.Y.U.L. Rev. 1113, 1122-27 (1985).

124 See, e.g., Moore & Viscusi, Doubling the Estimated Value of Life: Results Using New Occupational Fatality Data, 7 J. Pol. Anal. & Man. 476 (1988) (using new series of data that increases implied value of human life). Viscusi's work on consumer risk valuation concentrates on morbidity or injury risk rather than mortality risk. See, e.g., W. Viscusi & W. Magat, Learning About Risk: Consumer and Worker Responses to Hazard Management (1987); Viscusi, Magat, & Forrest, Altruistic and Private Valuations of Risk Reduction, 7 J. Pol. Anal. & Man. 227 (1988).

Neither the offer nor the asking price necessarily represents a "correct" value of life.[125] Agencies could, of course, incorporate different values for different regulatory schemes. Thus, a regulation that required warning labels for risky products might be cost-effective at a level lower than a regulation governing clean-up of toxic waste dumps, even though the number of lives at risk was the same in the two cases. Alternatively, regulations that are cost-effective from one perspective might not be cost-effective from the other. Assume, for instance, that offer prices imply a value of life in the $1-2 million range while asking prices imply a $3-4 million figure. A regulation that cost $2.5 million per life saved would only be implemented on pure cost-benefit reasoning if the latter figure were used. Obviously, this problem increases with the magnitude of the variation in offer and asking prices. Minor variations are unlikely to render the efficiency of a proposed regulation dependent on the selection of a maintenance or compensation standard for valuing lives.

4. Ex Ante/Ex Post Losses and the Use of Jury Awards.

Our discussion to this point has underscored one particular feature of hazard rulemaking -- its focus on statistical lives. That is to say, these rules recognize that a particular activity puts life at risk; based on historical experience, projections can be made concerning the number of lives so risked. Administrative regulation, however, takes place ex ante, before any of the people actually placed at risk can be identified individually. Although ex ante regulation may be able to narrow the group from which the ultimate victims will come, e.g., workers in a particular industry or consumers of particular products, we cannot more precisely predict who will fall victim to society's desire to pursue the activity, notwithstanding its inevitable human cost. It is within this context that regulators assign values to life and consider the offsetting benefits.

Once the risk materializes, however, we typically are able to identify the individual victim. At this point, a particular application of the "soft variables" discussed above comes into play. Once we must make a decision ex post whether to save an individual life, we do not withdraw to a naked statistical analysis of the cost effectiveness of the effort. Certainly, our attitude is not, "if the risk was not worth saving prior to its materialization, it is not worth saving now." Instead, we appear willing to invest almost limitless resources in saving identifiable individuals who, from an ex ante perspective, were not worth saving from exposure to risk. Readily available examples include miners trapped in mines that might have been made safer (at a cost earlier deemed unwarranted), earthquake victims buried under the rubble of buildings (previously considered safe enough), or children trapped in wells (theretofore considered not worth plugging). Numerous commentators have suggested that the kinds of regulatory calculations that generate safety and health standards have no applicability to these ex post cases.[126] We seem not only to recognize the "sacred value" of human life when it is made so salient. We may also be moved by some sense of equity to attempt a rescue the cost of which exceeds the ex ante statistical value of the victim. Having rejected (at least implicitly) precautionary action as too costly, we subsequently have a particular threatened victim on our hands. Once we know who must pay the cost of conferring the benefits (namely, avoiding costs of ex ante reduction of

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125 For discussions of the offer-asking problem, see Carlson, Reforming the Efficiency Criterion: Comments on Some Recent Suggestions, 8 Car. L. Rev. 39 (1986); Kennedy, Cost-Benefit Analysis of Entitlement Problems: A Critique, 33 Stan. L. Rev. 387 (1981); Markovits, Duncan's Do-Nots: Cost-Benefit Analysis and the Determination of Legal Entitlements, 36 Stan. L. Rev. 1169 (1984).

126 See Calabresi & Bobbit, Tragic Choices (1978); Sagoff, Sense and Sentiment in Occupational Safety and Health Programs, 179, 183, in D. Nelkin (ed.), The Language of Risk: Conflicting Perspectives on Occupational Health (1985); Schelling, supra note 94.

hazards) on the rest of us, it seems appropriate to reduce the burden to that threatened victim, especially when we can do so without losing all the benefits that we have captured by imposing the obligation to sacrifice on some theretofore anonymous victim. It may well be for these reasons that the Environmental Protection Agency, in its thorough 1983 survey of risk reduction valuation approaches, states that: "(a)lthough there is not a clear consensus in the literature, the arguments for the use of ex ante, unidentified risk valuations in policy evaluation are persuasive."[127]

This ex ante/ex post distinction suggests why jury verdicts and settlements in wrongful death cases might be an inappropriate basis for regulatory life valuations. Those awards focus on the particular earnings and family situation of a known individual, for quite plausible reasons. It is commonplace in these proceedings for evidence on income loss to figure importantly in outcomes. Yet certain factors imply that juries would use their substantial discretion, especially where they may consider pain and suffering, to assign high values to life. Juries in such cases will be determining damages only after a finding of liability, of wrongdoing by a defendant. It is conceivable that, faced with a negligent or otherwise blameworthy actor, juries will tend towards overcompensation as a punitive measure.

In addition, juries are not repeat players; they look only at the effects of a particular case. Each jury that considers damages may fail to consider the cumulative effects of overcompensation in the aggregate of cases. Thus, total or average jury awards are likely to represent an example of the "tragedy of the commons" phenomenon in which individual action -- while relatively harmless in isolation -- can accumulate to produce major social dislocations.

Interestingly, while these biases suggest that jury verdicts will produce ex post life valuations that are "too high," existing research indicates that verdicts are uniformly below the generally accepted willingness-to-pay figures. Machol states:

> All such methods come out with values under one million dollars per life. In the case of settlements by insurance companies in major aircraft accidents, the average 10 years ago was under $200,000 and is now several times as large, though still less than one million dollars.[128]

Viscusi reports that: "The average bodily injury payment for fatalities in product liability cases is about $212,000 (1982 dollars) . . . ."[129] Finally, Miller found that "the average jury award for wrongful death . . . has risen to about $1,000,000."[130] Nevertheless, Miller believes that as the willingness-to-pay approach becomes more firmly established in the regulatory area, it will have the indirect effect of driving up jury awards in wrongful death cases, substantially narrowing currently observable valuation discrepancies.[131]

Values derived for wrongful death purposes are not frequently utilized now in regulatory settings, but they nevertheless continue to attract some regulatory attention. In

127 EPA, supra note 7, at 5-2. Much the same point is made in OMB, supra note 5, at xix-xxii.
128 Machol, How Much Safety?, 16 Interfaces 4 (Nov./Dec. 1986).
129 Viscusi, in Bentkover at 202.
130 Miller, supra note 82, at 5 as well as Federal Highway Administration, Alternative Approaches to Accident Cost Concepts: State of the Art.
131 Id.

its current guide (issued in 1981) for valuing life, the Federal Aviation Administration noted approvingly that, while the FAA valuation methodology is not a human capital one, the value it yields "approximates the average 1979 judicial settlement of $503,000, after making an allowance for inflation."[132] Moreover, vestiges of human capital reasoning linger on in some regulatory areas, mainly at the National Highway Traffic Safety Administration according to Miller.[133] But on the whole, human capital valuation in regulatory situations has lost whatever adherents, e.g., OSHA, it formerly had.

A final point reinforces the argument implicit in what we have said to this point concerning vicissitudes in human life valuation in different contexts. Even from an ex ante perspective, lives may carry different values depending on whether we are talking about certain death for a given number of unknown persons or a risk of death for a larger group of persons, so that the expected deaths in the two groups are equal. Assume, for instance, that we must decide which of two strategies to follow. One will avoid certain death to a single, unidentified individual in a population of 100,000. The other will reduce to zero a risk that otherwise would cause to each individual in the same population a 1 in 100,000 risk of death. If the two strategies cost the same, is there reason to favor one over the other? In a survey based on these alternatives, Jones-Lee, Hammerton, & Philips found that respondents did care about which alternative was selected, with a mild preference for avoiding the certain, but anonymous, death over the purely statistical one.[134] Nevertheless, such preferences will not be reflected in willingness-to-pay studies that draw on contexts that fail to distinguish among the various situations in which valuations of life are required.

These criticisms of the willingness-to-pay approach strongly suggest that the methodology is inappropriate for defining an exact figure that represents the value of human life. Failure to accomplish that objective, however, does not necessarily render willingness-to-pay studies irrelevant to agency determinations of regulatory impact. If incorporation of soft variables and externalities and correction of informational and cognitive errors did not produce figures for the valuation of human life several magnitudes greater than the flawed processes currently used, then it is unclear that existing distortions would make substantial difference in many cases. For instance, if imperfect willingness-to-pay studies support a human life valuation of approximately $5 million,[135] then even a perfectly performed valuation (assuming such a method could be designed) may not justify implementation of a regulation that cost $50 million per life saved if the corrections incorporated in the study did not justify a tenfold increase in the value of human life. Our critique of willingness-to-pay, therefore, should be understood less as an appeal to ignore these studies than as a warning to understand their limitations. Acceptance of findings from these studies should be viewed most skeptically where they produce dollar values close to the cost per life of proposed regulations, for it is in those situations that failure to consider all relevant variables will have the greatest impact on ultimate result.

IV. Discounting -- A Hybrid Philosophical and Economic Issue

1. Introduction.

132 FAA, Economic Values for Evaluation of FAA Investment and Regulatory Programs 27.
133 Miller, supra note 82, at Table 1.
134 See Jones-Lee, Hammerton, & Philips, supra note 100, at 64.
135 See Moore & Vicusi, supra note 124.

The decision to regulate a suspected health or safety hazard represents a judgment that some mandated change in behavior or circumstance will lessen the risk of illness or accident. The decreased risk constitutes a social benefit, valuation of which constitutes the central concern of this report. The mandated change typically imposes burdens on those required to comply with the regulation. (If it did not, i.e., if the benefits of the risk reducing measures could be captured -- through market measures or otherwise -- by those required to take them, presumably risk reduction would occur voluntarily.) These benefits and burdens, however, may occupy very different temporal frames. The benefits of regulation often will not be realized until a substantial period of time after their costs have been incurred. This is particularly the case where benefits take the form of avoiding injuries or illnesses characterized by long latency periods. For instance, in reviewing a proposed rulemaking concerning coke ovens, OMB assumed that cancers would typically not materialize for seven years after the exposure that would be avoided through regulation. If one defines the "injury" that regulation addresses as the manifestation of the cancer rather than the initial exposure, there is a significant temporal gap between the period in which the costs necessary to avoid the exposure are incurred and the point at which benefits of injury avoidance materialize. In cases of substantial latency periods, e.g., storage of nuclear waste where current regulations may prevent harms from materializing in 10,000 years,[136] the benefits of current regulations may be conferred on those who have little relationship to the individuals who incur the attendant costs.

This temporal disparity of costs and benefits raises issues of both philosophical and economic importance. These issues center on the use of "discounting" to enhance the comparability of regulatory options.[137] Discounting attempts to factor into any regulatory analysis the assumption that dollars invested in regulation presumably would otherwise have been invested in productive ventures with a positive rate of return. Thus, during the period between imposition of costs and realization of benefits, the dollars invested in regulation bear an opportunity cost equal to the productive value they would have generated through an alternative investment. As an economic matter, any comparison of the costs and benefits of a particular regulation should place these effects on a common basis by referring to their values at the same point in time. Discounting accomplishes that task by reducing the expected benefits to their present value or increasing the value of current costs to the period when benefits will be realized.

A simple example may illustrate the point. Adoption of one regulatory alternative may impose $10 million in compliance costs this year and none thereafter, while a second imposes $5 million this year and $5.5 million in two years. If both yield much the same payoff in social benefits (e.g., either measure would prevent 10 deaths in 10 years), how do we decide between the two? To say that the second alternative is $500,000 more costly ignores the fact that deferral lightens any burden, because interest can be earned until the cost is imposed. Discounting provides a sounder basis for comparison, as it takes into account the forgone earnings that the first alternative entails. We need "only" know the applicable interest rate to complete the analysis.

Obviously, discounting can have substantial impact on the relative merits of proposed regulation. For instance, in the coke oven example cited above, OMB estimated

136 See Murauskas & Shelly, Local Political Responses to Nuclear Waste Disposal, Cities 157 (May 1986).

137 We use "discounting" to refer to two distinct but related economic phenomena. Strictly speaking, "discounting" refers to the question of the present value of benefits that will not be received until some point in the future. Our discussion also involves "compounding," which refers to the question of the value in the future of a benefit received at present.

that the proposed regulations would cost approximately $2.2 million per life saved. These savings, however, would not be realized, under OMB calculations, for approximately seven years. Assuming an interest rate of 10%, the value of a current expenditure of $2.2 million per life doubles to $4.4 million over that seven year period. Thus, if one were to assume that a statistical life were worth approximately $2 million, the regulation might appear reasonable under a regime that compared undiscounted costs and benefits, but not once discounting entered the picture.

Alternatively, one may reduce (discount) future benefits to their present value to equate temporally costs and benefits. Thus, if a life worth $2 million will only be saved seven years hence, its discounted value today (again assuming a 10% interest rate) will be worth only about $1 million. Thus, a regulation that requires current expenditures in excess of $1 million per expected life saved would not be worth implementing on a pure cost effectiveness rationale. While this procedure may crudely be referred to as "discounting lives," it may more euphemistically be considered a comparison of the benefits of regulation with the benefits forgone by not investing the same dollars in some alternative enterprise. As a matter of economics, consideration of these opportunities is appropriate, as they constitute a loss of welfare from rendering the benefits of an investment unavailable for immediate consumption or reinvestment.[138]

Behind the logical force of discounting, however, lurks a semantic distinction that calls the propriety of the enterprise into question. We have to this point interpreted the assumed benefits of regulation as the avoidance of injury or illness that would otherwise materialize with a stated level of probability. It is the existence of a latency period between exposure to a hazard that generates the injury or disease and the onset of that adverse effect that requires attention to intertemporal costs and benefits. While the latency period properly measures the time between exposure and onset, however, avoidance of the injury at the end of that period does not necessarily constitute the salient benefit of regulation. Instead, one may consider regulation beneficial insofar as it reduces or totally avoids the risk that the injury or illness will materialize. *That* effect (risk reduction) arguably materializes as early as the time when the costs of regulation are incurred. In some cases, costs will be extended over a substantial period of time and risk reduction will not materialize until substantial investments have been made. Incremental cleaning of a heavily polluted water supply may be an example of such a phenomenon. Alternatively, risk reduction may be attained only through investment in a step good, so that no reduction occurs until a substantial investment has been made over a period of time. In such cases, the discounting issue remains, as there is still a temporal disparity between incurring costs and obtaining the benefits of risk reduction. Nevertheless, risk reduction may materialize before the latency period expires. Then the effect of discounting for any given discount rate will be less significant than if the discounted benefit were defined solely as the avoidance of the injury at the end of the latency period. In other cases, incurrence of costs and risk reduction will be simultaneous, e.g., the removal of asbestos insulation from a building. In such a case, defining risk reduction as the regulatory benefit effectively eliminates the need for discounting. At the very least, the risk reduction period eliminates certain costs, such as those related to anxiety otherwise produced in an exposed population concerning whether they will ultimately contract the feared disease.[139]

138 See Baumol, On the Social Rate of Discount, 58 Am. Econ. Rev. 788 (1968).

139 For cases dealing with liability for anxiety within an exposed population about contracting subsequent disease or injury, see Hagerty v. L & L Marine Services, Inc., 788 F.2d 315 (5th Cir. 1986); Sterling v. Velsicol Chemical Corp., 647 F. Supp. 303 (W.D. Tenn. 1986); Eagle-Picher Industries, Inc. v. Cox, 481 So. 2d 517 (Fla. App. 1985); Payton v. Abbott Labs, 386 Mass. 540, 437 N.E.2d 171 (1982).

There is substantial logic in using the risk-reduction period rather than the end of the latency period (the time between exposure and manifestation of injury) as the benchmark of benefit. Assume, for instance, that a carcinogenic agent were removed from an environment in which it presented a .001 probability of causing cancer. But for removal of the agent, it would have been most unlikely that an individual exposed to that environment would contract cancer. Nevertheless, we would not say that the individual received no benefit from the removal. Instead, we would say that the individual benefited from elimination of a .001 chance of contracting cancer. But if that is the case, then that benefit materialized not at the end of the latency period for the carcinogen, but at the time when the risk was removed, i.e., when the costs of removal were incurred. Since the costs and benefits occurred simultaneously, there is no need to discount.

Nevertheless, exclusive focus on the risk-reduction period could lead to questionable, if not perverse, results. Assume, for instance, that we could spend $x on either of two programs. Program A would immediately remove a risk expected to cause the deaths of 100 people in 5 years. Program B would immediately remove a risk expected to cause the deaths of 100 people in 20 years. Our intuition is that most people would prefer to spend the available funds on Program A. Perhaps this conclusion would be justified because more of the people who would be saved by implementing Program B can be expected to die of other causes during the latency period. Alternatively, saving lives sooner might be viewed as a benefit insofar as it permits quicker growth of the population (on the questionable assumption that having more people sooner is a benefit). If our intution is correct, however, then the objective that it seeks to attain can be reached only by focusing on the latency periods of the harms avoided by the two Programs. Focus on the risk reduction period alone leads one to be indifferent between the two Programs as they immediately reduce the same quantity of risk. The only way to use risk reduction as a benchmark in this example and still reach the intuitively correct result is to consider the time period when lives will be saved when comparing the costs of risk reduction to their benefit. That inquiry, however, reintroduces the discounting quagmire through the back door.

Notwithstanding the complexity of these arguments, current federal government practice is to discount benefits from the end of the latency period. In the remainder of this section, therefore, we will evaluate the arguments and methodology concerning discounting. In our discussion, we will refer to the time between exposure to a risk and onset of the related illness or injury as a latency period and to the gap between incurring the costs of risk reduction and materialization of risk reduction as the pre-reduction period.

2. The Arguments Against Discounting.

Notwithstanding the economic logic of discounting, the procedure has met with considerable philosophical debate. To some extent, the temporal divergence of those who benefit from injury avoidance and those who pay for it suggest that discounting may be necessary to reduce intergenerational inequities. As latency periods and pre-reduction periods increase, the question of discounting raises the issue of the extent to which we owe obligations to future generations. Should full costs of injury avoidance be incurred by the present generation while benefits are realized only in the future, those future individuals who benefit from current investment in safety will bear none of the commensurate burden. Simultaneously, injury avoidance costs borne by the present generation will constitute forgone opportunities for current consumption or alternative investment that might provide a very different temporal mix of benefits and burdens.

For the most part, however, the philosophical debate reflects a different view of intergenerational justice. For instance, some commentators contend that since the question of when one exists is purely a matter of fortuity, discounting benefits to justify current

consumption at the expense of future generations accords to the latter an insufficient level of respect.[140] Implicit in this view is the (debatable) view that future generations will share the preferences of the current generation. Thus, it is anticipated that they will value the same amenities of life that are currently cherished. Should preferences change in some unexpected way, we would be faced with the extraordinary difficulty of predicting future concerns and comparing the worth of intertemporal preferences.[141] If preferences adapt to what is currently available (a "sour grapes" approach to amenities), then it is likely that future scarcity imposed by curent consumption will not necessarily adversely affect the enjoyment of future generations. Assume, for instance, that future generations value wilderness areas less highly than the current generation does. If that change were to materialize, future generations would look askance at current decisions to forgo technological advances in order to preserve natural settings for posterity.[142]

Putting to one side the difficulties of changed preferences, discounting raises serious issues of the relative importance of succeeding generations. Derek Parfit has argued, for instance, that applying a social discount rate of x percent per year tends to ignore future events as "morally trivial," at least in the situation where decision makers literally "discount lives" by finding that a number of future lives is equivalent to a smaller number of present lives.[143] Parfit postulates a scenario in which nuclear waste causes one billion deaths in 500 years. At a discount rate of only 5%, those deaths are equivalent to a single death today. Thus, if we would not be willing to expend the resources necessary to avoid one death today, discounting suggests that we should be similarly unwilling to spend that sum, even though the benefit would instead be the certain saving of one billion deaths in 500 years. For Parfit, discounting in this manner suggests that the moral significance of these future deaths has declined, a conclusion he deems unjustifiable.

Parfit concludes that the opportunity cost explanation for discounting does not justify the use of the procedure. He posits a case in which benefits would be consumed, rather than reinvested, e.g., the natural beauty of the countryside that would be destroyed by construction of a proposed airport.[144] In Parfit's view, future generations do not receive any increased value from a reinvestment of the current generation's appreciation of the countryside. Thus, the future's enjoyment of the view cannot be discounted to reflect any present value.

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140 The debate about this attitude is evidenced in a dialogue between a geologist who wishes to mine in the Cascade Mountains and a conservationist who wishes to preserve them, as recounted in J. McPhee, Encounters with the Archdruid: Narratives About a Conservationist and Three of His Natural Enemies 74 (1971):

> "The future can take care of itself," Park said. "I don't condone waste, but I am not willing to penalize present people. I say they're penalized if they don't have enough copper. Dave says they're penalized if they don't have enough wilderness."

Implicit in this statement is the important lesson that all courses of action impose costs. The issue then, is not cost avoidance, but cost optimization.

141 See Golding, Obligations to Future Generations, 56 Monist 97 (1972). But see Kavka, The Futurity Problem, in R. Sikora & B. Barry, Obligations to Future Generations 186, 189-92 (1978).

142 See e.g., Krieger, What's Wrong with Plastic Trees?, 179 Science 446 (1973).

143 See D. Parfit, supra note 115, at 357.

144 Id. at 483.

This is not to say that Parfit believes that future benefits must always be weighed against current costs as if the two were contemporaneous. Instead, he argues that:

> conclusions that are established by such (opportunity cost) calculations could be re-expressed in a temporally neutral way. When describing the effects of future policies, economists could state what future benefits and costs there would be, at different times, in a way that used no discount rate. The arguments that appeal to opportunity costs could be stated in those terms.[145]

Parfit's suggestion is somewhat confusing. It is unclear whether he is permitting decision makers to consider at all the issue of when the costs and benefits of a policy will materialize. Further, his conception of a "temporally neutral" decision ignores the fact that while discounting favors present benefits over future ones, failure to discount does just the opposite. "Neutrality" in this situation seems rather fictitious. At a minimum, however, Parfit seems concerned that formal calculations of a discount rate and current valuations of future benefits will interfere with, rather than assist, intuitive judgments concerning alternative policies. Even here, though, intuitions are not unidirectional. Substantial writing suggests that we have obligations to those with whom we are in a special relationship that exceeds our obligations to strangers.[146] As a legal matter, some special relationships trigger obligations not present to the public at large.[147] The temporal extension of this view would hold that we have obligations to those who currently exist that do not necessarily extend to those yet to be born.

In a vein similar to Parfit, Peter Railton has argued that discounting produces perverse effects insofar as it favors policies that produce short-term benefits while imposing long-term costs.[148] Railton's argument is a direct attack on those who, apart from discounting, contend that it is sensible to impose costs, e.g., environmental harms, on future generations because they are likely to possess technological advances necessary to bearing those costs. Railton argues instead that caution is appropriate when considering future effects -- particularly in the environmental area -- because "(i)t is . . . almost always easier to do than to undo ecological damage."

Railton attempts to demonstrate the perversity of discounting by postulating two policies, A and B. The former will save 8 "present" lives while causing 12 "surplus" deaths in 15 years. The latter has only future effects: it will save the lives of 14, and cause the death of 12, both in 15 years. Railton suggests that discounting would favor the former policy, notwithstanding that it causes more "actual" deaths than it saves, because (assuming a discount rate in which money doubles every 15 years) the 8 current lives have a dollar equivalent of 16 lives when the costs materialize. (Railton's argument is couched largely in terms of the propriety of monetizing human life, an approach that he implies necessarily entails some use of human capital evaluations. As we find that approach inappropriate, but unnecessary, we couch his argument in more generic terms of numbers of lives). He seconds Parfit's view that discounting provides little basis for deferring adverse effects that have no economic value and, thus, cannot appreciate: "the gain in happiness to a family

145 Id. at 484.
146 See Anderson, Values, Risks, and Market Norms, 17 Phil. & Pub. Aff. 54, 58 (1988); Fried, supra note 71.
147 See, e.g., Tarasoff v. Regents of University of California, 17 Cal.3d 425, 551 P.2d 334, 131 Cal. Rptr. 14 (1976).
148 See Railton, The Search for a Single Metric (unpublished manuscript 1987).

that does not lose a beloved member in, say 1987, will not compound at a social rate of interest to become an amount of well-being large enough to offset the bereavement of two families, each of whom loses a beloved member in 2002."[149]

The lesson learned from this critique is not that discounting is always inappropriate. Both Parfit and Railton suggest that discounting may be useful, as when there exist predictable technological improvements that will render future generations better able to deal with costs while still enjoying benefits conferred by the present. Rather, the appeal of the critique lies in its implicit rejection of a unitary conception of societal assets. Some assets increase in value over time and are thus susceptible to discounting. Others, however, may be so idiosyncratic, irreplaceable, or external to market transactions that they are less vulnerable to the arguments (compounding interest and opportunity costs) that underlie discounting. The important regulatory implication, therefore, is that a uniform approach to the issue of discounting may not be suitable; some analysis will first be needed of the types of future costs and benefits and their susceptibility to intertemporal comparisons.

3. OMB Discounting Guidance and Agency Practice.

In 1972, the Office of Management and Budget issued Circular No. A-94 to establish a common discount rate for use throughout government, except where statutes prescribed alternative rates. OMB selected a rate of 10%, which remains unchanged, as "an estimate of the average rate of return on private investment, before taxes and after inflation".[150]

While much discussion has ensued over the years about the suitability of this rate, a topic we take up in the next section, OMB has continued to urge use of the 10% rate in agency analyses of both the costs and benefits of regulations, as well as of other agency programs. However, since 1981, OMB has taken the position that any agency should feel free to supplement use of the 10% rate with analysis showing the sensitivity of the outcomes to selection of any other rates the agency thinks applicable.[151]

Moreover, in the 1987-88 edition of the Regulatory Program of the United States,[152] OMB's discussion of discounting practices and objectives calls attention in non-judgmental fashion to cases in which agencies have relied on rates other than 10%, and OMB is silent on whether use of that figure continues to be desirable. Indeed, in our discussions OMB staff indicated that, in light of work done by Lind and others, 10% is not always the best choice.

Whatever the particular discount rate selected, OMB has argued consistently that the same rate should be applied to benefits and to costs. This normally involves computing the present values of each (although OMB points out that alternatively agencies can annualize the benefit and cost streams over the same time frame).[153] Nonetheless, agencies not infrequently depart from this practice, declining to apply discounting to future benefits at all, or using a lower discount rate for benefits.

149 Id. at 37.
150 Circular No. A-94 at 4.
151 See OMB's Interim Regulatory Impact Analysis Guidance.
152 See OMB, supra note 5, at xxi.
153 Id. at xxii.

The Regulatory Program cites two OSHA rulemakings (for asbestos and ethylene oxide) where the agency applied a 10% discount rate to costs but did not discount benefits at all, and another EPA rulemaking (for lead phasedown) where discounting occurred at a three percent rate.[154] By contrast, EPA, in its December 1986 analysis of drinking water lead risks, used a five percent discount rate for benefits from reducing lead in drinking water, while adhering to the 10% rate for costs.[155] At NHTSA, the preferred discount rate is seven percent,[156] although its parent Department of Transportation suggests that all parts of the department should be complying with the OMB prescribed rate.[157] Actual discounting practices are indeed diverse.

4. Choosing the Discount Rate.

As noted in earlier sections, discounting may not always be suitable in evaluating fatality reduction benefits. But where discounting is desirable, the question remains of how best to choose the rate. Little agreement exists about the proper number or even about the correct methodology for finding the number. Under these circumstances, sensitivity analysis is particularly inviting. The idea is to show how much the results would differ by switching to alternative discount rates. Then, if the regulation looks appealing for a range of discount rates, it matters little which rate is optimal, and the discount rate choice can be side-stepped.

One obvious starting point for discount rate choice is OMB's current guidance. As noted above, OMB based its choice on the rate of return available on private investment. The logic is that a government project (or mandated expenditure for regulatory compliance) draws funds away from private investment projects, depriving society of the related productive activity. The pre-tax rate of return then is relevant, because society also experiences a loss of tax revenues if the capital investment is not made. Thus the discount rate is chosen to reflect the real opportunity cost of capital, and as such a 10% rate is not unreasonable. Indeed, some have suggested a rate anywhere in the range of 10 to 25% could be justified.[158]

However, the costs of regulation may take various forms, forgone capital investment being only one. In particular, the costs may show up as reduced consumption (through higher consumer product prices). Then a different conceptual framework is needed, and much work has been done in recent years to develop a suitable one.[159] To the extent that the compliance cost takes the form of reduced consumption, the regulation should be evaluated in terms of how people value a loss of present consumption. This we can accomplish by identifying the interest rate level high enough to induce people to postpone consumption, i.e., to save. While one can debate the precise number for this interest rate, often termed the "social rate of time preference," certainly the range is considerably lower than that for capital rates of return.[160]

154 Id. at xvii.

155 EPA, Reducing Lead in Drinking Water: A Benefit Analysis, III-58, IV-49.

156 The Economic Cost to Society of Motor Vehicle Accidents at V-4.

157 See DOT, Guidance for Regulatory Evaluations: A Handbook for DOT Benefit-Cost Analysis at 17.

158 R. Tresch, Public Finance: A Normative Theory (1981).

159 See Bradford, Constraints on Government Investment Opportunities and the Choice of the Discount Rate, Am. Econ. Rev. 887 (1975); Lind, Discounting for Time and Risk in Energy Policy (1982).

160 Tresch puts the range at 3 to 6 percent for the social rate.

The most promising discounting framework now appears to be one which in essence combines these two approaches, recognizing that both investment and consumption may decline near-term when regulation is imposed. The intent is to identify the portion of compliance cost that does displace private investment and then to translate that displacement into a corresponding forgone future stream of consumption -- consumption that will not take place because the capital investment necessary to generate it never took place. These "consumption-equivalent" costs of the regulation then can be added to the compliance costs that do not come at the expense of investment (that is, costs born by consumers right from the start). All costs thus can be portrayed as lost consumption, some now and some later. The final step then is to utilize the social rate of time preference as the discount rate in computing the present value of this stream of future effects.[161]

This falls short of providing a firm answer to the question of "What number?," in part because the most satisfactory approach conceptually (the framework just discussed) is not easy to apply empirically. But most would agree that 10% is too high a rate.

IV. Recommendations

The foregoing discussion leads us to recommend a series of measures for agency regulations that affect human life. Our recommendations are predicated on the belief that the uncertainties underlying valuations of human life provide agencies with substantial discretion in justifying decisions to implement or reject proposed regulations based on factors only tangentially related to the relative benefits that would be conferred through regulation. We are not suggesting that agencies have failed to adopt more precise measures that would improve the quality of their life valuations. To the contrary, we recognize that given the embryonic state of knowledge on this issue, both methodologies and results are likely to vary across agencies. Additionally, we are sensitive to arguments that lives should be valued differently in different contexts. In this environment, however, we believe it would be useful for agencies to take measures that would reveal publicly the processes through which they have determined the valuation of life incorporated in policy decisions. In this way, agency practice can be measured against developments in the valuation area and evaluated for consistency with other agencies and other regulations in the same agency. Most importantly, full disclosure of agency practices provides the best way to hold agencies accountable for selecting a particular set of variables for consideration and excluding others. Toward these ends, we recommend the following procedures.

1. Agencies that adopt regulations substantially on the justification that reduction of risk to human lives warrants incurring the associated implementation and compliance costs should state an explicit valuation utilized, or should disclose the cost per statistical life saved implicit in that determination. Such a procedure will provide useful clarification and exposition of the unavoidable tradeoffs involved in regulating hazards and assist in drawing attention to those hazards where further protection may be feasible at acceptable cost. This is not to say that decisions about relative costs and benefits of a proposed regulation cannot be trumped by other variables. We believe, however, that the explicit values used by an agency is a relevant datum to be used by political decision makers in determining whether to employ those trumps. Exceptions to this principle might exist where empirical information about either the regulation's costs or benefits is highly conjectural or where the

161 Fuller discussions of this approach appear in Lind, supra note 149; Staiger & Richardson, A Discounting Framework for Regulatory Impact Analysis, 18 Policy Sciences 33; EPA, Guidelines for Performing Regulatory Impact Analysis, Appendix C.That the same rate should be applied to benefits as to costs is discussed in DOT, 1 Methods for Economic Assessment of Transportation Industry Regulations III-17.

benefits include a variety of non-market improvements where monetizable benefits are not obvious, e.g., aesthetic gains. In such cases, efforts to characterize accurately the imprecision of the valuation process may minimize the perception of substantial certainty.

2. We believe that continued use of willingness-to-pay methodology to place value on human life requires more attention to the limitations of that approach. While willingness-to-pay provides the most inclusive analysis currently available for evaluating the benefits derived from regulatory reduction of fatalities, it falls far short of an ideal process and can produce results that are misleading for failure to consider all variables relevant to an inclusive valuation process. While current willingness-to-pay investigations incorporate factors not considered in alternative methodologies, they cannot satisfactorily account for informational disabilities or cognitive error in the respondent population. We recommend, therefore, that any valuation of life, whether based on willingness-to-pay or an alternative methodology, be accompanied by a statement of variables that the agency believes to have been slighted or omitted from consideration but that would affect (positively or negatively) the explicit values derived. The agency should also explain how it takes account of any such additional factors.

3. OMB'S Circular A-94 concerning the use of a discount rate should be revised to reflect learning on the subject since the time of its promulgation. We do not endorse the adoption of a specific discount rate. Rather, we recommend that a revised Circular articulate the various methods by which a discount rate can be derived and the scope of subjects to which it can be applied. However agencies choose to discount costs and benefits, they should clearly and fully disclose what rates they are using, the methodology that generated those rates, and the sensitivity of outcomes to the particular rates applied.

4. While uniform practices in the life valuation area may not be warranted (because of the diversity of hazard situations, as well as the inconclusive nature of much of the empirical information on which decisions are based), there is justification for greater interchange of information among agencies on how decisions are made and utilized in this contentious area. Thus, we recommend the creation of a central clearing house for research on valuation issues. To this end, we suggest that OMB expand its discussion of agency practices, initiated in the 1987-88 volume of the annual Regulatory Program and make such discussion a standard practice.